

University of Huddersfield Solar PV

Specification Section C

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V14 PHOTOVOLTAIC SYSTEMS

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V14.1 PART 1 - GENERAL

V14.1.1 RELATED DOCUMENTS

A Where relevant this document is to be read in conjunction with the following General Engineering clauses:

- 1 For testing and commissioning refer to section Y50
- 2 For services identification refer to section Y32
- 3 Building monitoring and management systems Y41
- 4 Fixing to building Fabric Y90.

V14.1.2 SUMMARY

A This section covers the provisions for the, supply, installation and commissioning of Photovoltaic modules/c panels for electricity generation. Section includes the following:

- 1 Delegated Design of Photovoltaic installations
- 2 Photovoltaic Panels
- 3 Single Phase Solar Inverters
- 4 Three Phase Solar Inverters

V14.1.3 DEFINITIONS

A The following abbreviations and definitions are used throughout this section

- 1 Micro-cogeneration: Systems which have an thermal and electrical output of less than 45kW_t or 50kW_e.
- 2 BMS: Building Management System.
- 3 kW_e: Electrical peak output power rated at STC
- 4 STC: Standard Test Conditions 25°C; light-1000W/m²; air mass spectral distribution 1.5; cell temperature 25°C
- 5 Efficiency: The operating efficiency of a solar collector is the ratio of the collector output to the power input. Relevant variables are, for example, the ambient and absorber temperatures.
- 6 DNO: Distribution Network Operator
- 7 Inverter: A device for the conversion from Direct Current to nominal frequency Alternating current
- 8 Nominal Voltage and Frequency:
 - a Single phase: 230V AC (+10/-6%), 50Hz (±1%)
 - b Three phase: 400V AC (+10/-6%), 50 Hz (±1%)
- 9 SSEG: Small scale embedded generator. A generating unit together with any associated equipment such as inverters that can be used independently rated up to 16A per phase.
- 10 PV Array: Mechanically and electrically integrated assembly of PV modules and other necessary components to form a d.c. power supply unit.
- 11 MPPT: maximum Power Point Tracking

V14.1.4 DELEGATED DESIGN – PHOTOVOLTAIC INSTALLATIONS

A Delegated Design: Employ the services of a specialist Solar PV company to design, supply, install, clean, test and commission the complete power generation system including the controls, alarms and safety interlocks all in accordance with MIS 3002

B Ensure that the specialist company is registered under the BSI quality assurance scheme. For micro-cogeneration they must have certification to MCS 001 and Green Deal Authorised under MCS 023.

C Provide the PV modules as an integral "Turnkey" package designed and installed by the specialist company to operate as a "stand alone" or "parallel" package with automatic control that requires minimal or no supervision. Refer to section B and schedules of equipment for plant mode of operation.

- D For array location, orientation and areas refer to drawings;
- E Carry out the following design checks:
 - 1 Shading impact study where applicable to produce % reduction in output over the design year
 - 2 Provide weights of the installation and verify with structural engineer that structure can support the installation including any snow loads.
- F For connection of PV to the national grid design install and commission the systems to comply with the following:
 - 1 For small scale <16A per phase: ENA ER G83 (this is 3.68kW on a 230V supply or 11.04kW on a 400V supply.
 - 2 For larger scale >16A per phase: ENA ER G59
- G Comply with the DNO requirements and seek approval of the installation before connection to the grid. Obtain approval in the form of a "Connection Agreement" from the local DNO. The DNO will also require to witness the testing of the G59-3/G83 compliant controller before permitting operation.

V14.1.5 SUBMITTALS

- A Product data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties and accessories:
- B Approvals: prepare information for local approvals including DNO agreement for photovoltaic installation, EIA, and operating licences. Submit all regulatory authority approvals and any necessary licences.
- C Shop drawings: Include plans, elevations, sections, details and attachments to other work:
 - 1 Detail equipment assemblies and indicate dimensions, weights, load distribution, required clearances, method of field assembly, components, and location and size of each field connection
 - 2 Wiring diagrams: For power, signal, and control wiring.
- D Coordination drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1 Structural supports
 - 2 Wiring roughing-in requirements, including spaces reserved for electrical equipment
 - 3 Access requirements, including working clearances for electrical equipment, and service clearances.
- E Source quality-control reports.
 - 1 Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria based on STP operating conditions.
- F Start-up service reports:
 - 1 Operation and maintenance data: For each Photovoltaic array to include in emergency, operation, and maintenance manuals.

V14.1.6 QUALITY ASSURANCE

- A Ensure Photovoltaic products are designed, constructed and installed with reference to the requirements of the following Building Regulations and those that particularly apply are:
 - 1 England and Wales
 - a Part A – Structure: ensuring the building, solar collector and fixing system can withstand the calculated loads for the site
 - b Part B – Fire Safety: ensuring the fire performance of the existing roof covering is not adversely affected

- c Part C – Resistance to contaminants and moisture: ensuring the weather tightness of the structure is not adversely affected
- d Part G - Sanitation, Hot Water Safety and Water Efficiency
- e Part L - Conservation of fuel and power
- f Part P – Electrical Safety

B Ensure Photovoltaic products are designed, constructed and installed with

- 1 BS EN ISO 9488: Solar energy. Vocabulary
- 2 BS EN 62446: Grid connected photovoltaic systems - Minimum requirements for system documentation, commissioning tests and inspection
- 3 IEC 61215:2005: Crystalline silicon terrestrial photovoltaic (pv) modules - Design qualification and type approval
- 4 IEC 61730-1: Photovoltaic (pv) module safety qualification - part 1: requirements for construction
- 5 IEC 61730-2: Photovoltaic (pv) module safety qualification - part 2: requirements for testing
- 6 BS EN 61215: Crystalline silicon terrestrial photovoltaic (PV) modules. Design qualification and type approval
- 7 BS EN 61646: Thin-film terrestrial photovoltaic (PV) modules. Design qualification and type approval
- 8 MCS: Microgeneration Certification Scheme: Installers and products to comply with
 - a MCS 001 – Installer certification scheme document
 - b MCS 012 – Product Certification Requirements: Pitched Roof Installation Kits.
 - c MCS Domestic RHI Metering Guidance
- 9 MIS 3002: Requirements for contractors undertaking the supply, design, installation, set to work commissioning and handover of solar photovoltaic (pv) microgeneration systems
- 10 CEN: Solar Keymark Scheme
- 11 CE Mark
- 12 BPVA: British Photovoltaic Association
- 13 ENA ER G59/3: Energy Networks Association Engineering Recommendations For the Connection of Generating plant to the Distribution Systems of Licensed Distribution Network Operators
- 14 ENA ER G83/2: Energy Networks Association Engineering Recommendations for the Connection of Type Tested Small –scale Embedded Generators up to 16A per phase in parallel with low voltage distribution system
- 15 2006/95/EC The Low Voltage Directive
- 16 2004/108/EC Electromagnetic Compatibility
- 17 BS 7671+ A3: Requirements for Electrical Installations. IET Wiring Regulations (all parts – but in particular Part 7-712 Requirements for special installations or locations – Solar photovoltaic (PV) power supply systems)
- 18 BS EN 50438: Requirements for the connection of micro-generators in parallel with public low-voltage distribution networks.
- 19 BS EN 62116: Test procedure of islanding prevention measures for utility-interconnected photovoltaic Inverters.
- 20 BS476-3: Fire tests on building materials and structures. Classification and method of test for external fire exposure to roofs
- 21 BS EN 13501-5: Fire classification of construction products and building elements. Classification using data from external fire exposure to roofs tests)

V14.1.7 DELIVERY, STORAGE, AND HANDLING

A Comply with manufacturer's requirements

V14.1.8 CO-ORDINATION

A Coordinate sizes and locations of structural supports, bases with actual equipment provided. Coordinate sizes, locations, and anchoring attachments of roof mounted structures.

B Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

V14.2 PART 2 - PRODUCTS

V14.2.1 PHOTOVOLTAIC MODULES/PANELS GENERAL

- A For array location and orientation refer to drawings.
- B Manufacturers: Subject to compliance with requirements, provide products by one of the following companies:
 - 1 Sunpower
 - 2 Trina
 - 3 JA Solar
- C Photovoltaic cells consist of one or two layers of a semiconductor material, usually silicon in which an electric field is generated by the action of direct or diffuse sunlight. There are three main types:
 - 1 Monocrystalline: comply with IEC 61215
 - 2 Polycrystalline: comply with IEC 61215
 - 3 Thin-film amorphous: glass-glass laminate: Comply with IEC 61646.
- D All panels/modules to comply with IEC 61730 – Photovoltaic (PV) module safety qualification
- E All modules to comply to Class II minimum standards.

V14.2.2 PHOTOVOLTAIC MODULE – MONOCRYSTALLINE TYPE PVM

- A Photovoltaic module comprises a glass laminate, with individual solar cells being embedded between two plastic (ethylene vinyl acetate) foils. Weather resistant cover foil is used as the back of the module. Panes and foils are laminated together to protect the cells reliably against external weather influences. The module is fully wired and suitable for roof mounted installation and horizontal or vertical locations.
- B Type: PVM 1: 15% efficiency. Electrical Performance parameters at STC conditions:
 - 1 Cell Dimensions:156 x156mm
 - 2 No of cells:60 (6x10)
 - 3 Panel Dimensions: 1640 x992 x50 mm
 - 4 Weight: 19.1 kgs
 - 5 Rated Power W; Module efficiency%; rated Voltage Vmp, Rated current Imp;
 - a 250W; 15.4%; 30.7V; 8.15A
 - b 245W; 15.1%; 30.5V; 8.04A
 - c 240W; 14.8%; 30.2V; 7.95A
- C Type: PVM 2: 20% efficiency. Electrical Performance parameters at STC conditions:
 - 1 Cell Dimensions:120 x120mm
 - 2 No of cells:96 (8x12)
 - 3 Panel Dimensions: 1559 x1046 x 46 mm
 - 4 Weight: 18.6 kgs
 - 5 Rated Power W; Module efficiency%; rated Voltage Vmp, Rated current Imp;
 - a 327W; 20.4%; 54.7V; 5.98A
 - b 320W; 19.8%; 54.7V; 5.86A
- D Type: PVM 3: 19% efficiency. Electrical Performance parameters at STC conditions:
 - 1 Cell Dimensions:120 x120mm
 - 2 No of cells: 72 (6x12)
 - 3 Panel Dimensions: 1559 x798 x 46 mm
 - 4 Weight: 15.0 kgs
 - 5 Rated Power W; Module efficiency%; rated Voltage Vmp, Rated current Imp;
 - a 245W; 20.1%; 40.5V; 6.05A

b 235W; 19.3%; 40.5V; 5.80A

V14.2.3 PHOTOVOLTAIC MODULE – POLYCRYSTALLINE TYPE PVP

- A Photovoltaic module comprises a glass laminate, with individual solar cells being embedded between two plastic (ethylene vinyl acetate) foils. Weather resistant cover foil is used as the back of the module. Panes and foils are laminated together to protect the cells reliably against external weather influences. The module is fully wired and suitable for roof mounted installation and horizontal or vertical locations.
- B Type: PVP1: 15% efficiency. Electrical Performance parameters at STC conditions:
- 1 Cell Dimensions: 125 x 125 mm
 - 2 No of cells: 72 (6x12)
 - 3 Panel Dimensions: 1665 x 991 x 50 mm
 - 4 Weight: 23.0 kgs
 - 5 Rated Power W; Module efficiency%; rated Voltage Vmp, Rated current Imp;
 - a 245W; 15.1%; 29.9V; 8.19A
 - b 250W; 15.4%; 30.1V; 8.31A
 - c 255W; 15.7%; 30.4.5V; 8.39A.

V14.2.4 PHOTOVOLTAIC MODULE - THIN FILM AMORPHOUS TYPE PVA

- A Photovoltaic module comprises an anti-reflection glass laminate, with individual monocrystalline silicon wafer solar cells being embedded between two layers of ultra-thin amorphous silicon set within black anodised aluminium frame. Weather resistant construction to protect the cells reliably against external weather influences. The module is fully wired and suitable for roof mounted installation and horizontal or vertical locations.
- B Type: PVA 1: 19% efficiency. Electrical Performance parameters at STC conditions:
- 1 Cell Dimensions: 125 x 125 mm
 - 2 No of cells: 72 (6x12)
 - 3 Panel Dimensions: 1580 x 798 x 35 mm
 - 4 Weight: 15.0 kgs
 - 5 Rated Power W; Module efficiency%; rated Voltage Vmp, Rated current Imp;
 - a 240W; 19.0%; 43.7V; 5.51A
 - b 235W; 18.6%; 43.0V; 5.48A
 - c 230W; 18.2%; 42.3V; 5.45A
- C Type: PVA 2: 18% efficiency. Electrical Performance parameters at STC conditions:
- 1 Cell Dimensions: 156x156mm (honeycomb)
 - 2 No of cells: 50 (5x10)
 - 3 Panel Dimensions: 1610 x 861 x 35 mm
 - 4 Weight: 16.5 kgs
 - 5 Rated Power W; Module efficiency%; rated Voltage Vmp, Rated current Imp;
 - a 250W; 18.0%; 34.9V; 7.18A
 - b 245W; 17.7%; 34.4V; 7.14A

V14.2.5 DC TO AC SOLAR INVERTERS FOR PV INSTALLATIONS GENERAL

- A Provide solar inverters to convert the DC generated current by the solar modules into high quality CO₂ free alternating current (AC) that can be fed into the distribution network.
- B Match inverters to system using manufacturers system sizing software. Ensure PV system will disconnect when the distribution system is not energised to avoid feeding the network or local distribution system during a planned or unscheduled loss of mains. Use products from one of the following manufacturers:

- 1 Sunpower
 - 2 Trina
 - 3 JA Solar
 - 4 ABB
 - 5 Kaco
 - 6 Viessmann
- C For multiple Strings/arrays: use inverter with MPPT function when arrays have different orientations or inclinations.
- D Ensure inverter can safely withstand the maximum array voltage and current.
- E Size inverter in the range: 100-80% of the array capacity.
- F Provide cooling either by natural means or by fan cooling.

V14.2.6 SINGLE PHASE MICRO INVERTERS

- A Type SP1- 250 W & 300W Inverters: Application: Micro Inverters for individual panel output control complete with computer-based monitoring capability. Suitable for outdoor installation.
- 1 Available Model Sizes: 250W & 300W. Characteristics for each model are indicated only where they are different.
 - 2 Input Side: for 250W & 300W models:
 - a Max DC power: 265 W, 320W
 - b Operating Voltage 12-60V, 30-50V
 - c No of DC input pairs: 1
 - d Max DC input voltage: 65V
 - e Max DC Input Current: 10.5A
 - f Start-up DC voltage: 25V
 - 3 Output Side:
 - a Rated AC power: 250W, 300W
 - b Max AC output current: 3A
 - c Rated frequency: 50Hz
 - d Nominal power Factor: >0.995
 - e Max number of units per phase: 17
 - 4 Operating Performance: 96.5%
 - 5 Communication: Wireless
 - 6 Ambient conditions: -40 to +75°C; 0-100%rh;
 - 7 Environmental Protection: IP 65
 - 8 Dimensions: 266x246x35mm
 - 9 Cooling: natural
 - 10 Construction standard: ENA ER G83

V14.2.7 SINGLE PHASE STRING INVERTERS 2.0 TO 4.2 KW

- A Type SP2 - 2.0kW & 2.5 kW Single Phase String Inverter: Application for string arrays with computer-based monitoring capability. Complete with MPP tracking. Suitable for outdoor installation
- 1 Available model sizes: 2kW; 2.5kW Characteristics for each model are indicated only where they are different.
 - 2 Input Side: for 2kW & 2.5kW models
 - a Max PV Generator power: 2kW; 2.5kW;
 - b MPP range: 200v to 470V
 - c Starting voltage: 200V
 - d Max Input current: 2x12.5A, 2 x 12.8A
 - e No MPP trackers: 1

- f Max Power/tracker: 2.3kW; 2.9kW
- g No of DC input pairs: 2
- 3 Output Side:
 - a AC Connection: Single phase
 - b Rated Output: 2kW,2.5kW
 - c Rated current: 10.5A;12.5A
 - d Max efficiency: 96.3%
 - e Power factor: 0.99
 - f Cooling: natural convection
- 4 Communications
 - a User Interface: Graphical display
 - b Communications Interface: RS-485 for connection to laptop or data logger or BMS
- 5 Ambient conditions: -25 to +60°C; 0-100%rh;
- 6 Environmental Protection: IP 65
- 7 Dimensions H X W X D: 518x367x161mm
- 8 Construction standard: ENA ER G83

B Type SP3- 3.0kW to 4.2 kW Single Phase String Inverter: Application for string arrays with computer-based monitoring capability. Transformerless operation. Complete with MPP tracking. Suitable for outdoor installation:

- 1 Available model sizes: 3kW;3.6,4.2 kW Characteristics for each model are indicated only where they are different
- 2 Input Side: for 3kW;3.6kW;4.2kW models:
 - a Max PV Generator power: 3.12kW; 3.75kW;4.375kW
 - b MPP range: 200v to 470V
 - c Starting voltage: 200V
 - d Max Input current: 20A; 32A;32A
 - e No MPP trackers: 2
 - f Max Power/tracker: 2kW;3kW;3kW
 - g No of DC input pairs: 1
- 3 Output Side:
 - a AC Connection: Single phase
 - b Rated Output: 3kW,3.6kW;4.2kW
 - c Rated current: 14.5A;17.2A;20A
 - d Max efficiency: 96.8%
 - e Power factor: 0.995
 - f Cooling: natural convection
- 4 Communications:
 - a User Interface: 16 characters x 2-line Digital display
 - b Communications Interface: USB for connection to laptop or data logger or BMS
- 5 Ambient conditions: -25 to +60°C; 0-100%rh;
- 6 Environmental Protection: IP 65
- 7 Dimensions H X W X D: 618x325x222mm
- 8 Construction standard: ENA ER G59

V14.2.8 3 PHASE STRING INVERTERS

A Type TP1 - 5.8,7.5 & 8.5 kW transformerless three phase inverters. Units provide integration of power control, monitoring and environmental inputs. Incorporating facilities for operating and fault conditions to be monitored locally and by the BMS system. Complete with DC switch and MPP tracker where indicated. Suitable for outdoor installation.

- 1 Available model sizes: 5.8kW; 7.5kW;8.5kW. Characteristics for each model are indicated only where they are different.

- 2 Input Side:
 - a Max PV Generator power: 5.95kW; 7.65kW;8.7kW
 - b MPP range: 320v to 800V
 - c Starting voltage: 350V
 - d Max Input current: 18.9A,30A,30A
 - e No MPP trackers:1,2,2
 - f Max Power/tracker: 4.8kW
- 3 Output Side:
 - a Rated Output: 5.8kVA;7.5kVA;8.5kVA
 - b Rated current: 10.0A,12.5A,14.5A
 - c Max efficiency: 98%
 - d Power factor: 0.8
- 4 Dimensions: 641x429x220mm
- 5 Cooling: Natural
- 6 Environmental protection rating: IP65
- 7 Isolation level: Transformerless
- 8 Construction standard: ENA ER G59
- 9 Data logger: with BMS interface for remote monitoring.

B Type TP2-10.0 & 12.0kW High speed, precise inverters with dual input sections to process two strings with independent MPPT trackers. Incorporating facilities for operating and fault conditions to be monitored locally and by the BMS system. Suitable for outdoor installation.

- 1 Available model sizes: 10.0kW; 12.0kW. Characteristics for each model are indicated only where they are different
- 2 Input Side:
 - a Max PV Generator power: 10.3kW; 12.8kW;
 - b MPP range: 300v to 750,360 to 750V
 - c Starting voltage: 3600V
 - d Max Input current: 34A,36A
 - e No MPP trackers: 2
 - f Max Power/tracker: 6.5 kW,8 kW
- 3 Output Side:
 - a Max Rated Output: 11.0 kW; 13.8kW
 - b Rated Voltage: 400V
 - c Rated current: 16A, 18A
 - d Max efficiency: 97.8%
 - e Power factor: 0.995
- 4 Dimensions: 716x645x222mm
- 5 Cooling: Natural
- 6 Environmental protection rating: IP65
- 7 Isolation level: Transformerless
- 8 Construction standard: ENA ER G59
- 9 Data logger: with BMS interface for remote monitoring.

C Type TP3-20 & 27.6kW transformerless high speed inverters with dual input sections to process two strings with dual independent MPPT. Incorporating facilities for operating and fault conditions to be monitored locally and by the BMS system. Suitable for outdoor installation.

- 1 Available model sizes: 20kW; 27.6kW. Characteristics for each model are indicated only where they are different.
- 2 Input Side:
 - a Max PV Generator power: 20.75kW; 28.6kW
 - b MPP range: 440to 800V, 500 to 800V
 - c Starting voltage: 360V
 - d Max Input current: 50A, 64A

- e No MPP trackers: 2
- f Max Power/tracker: 12kW,16kW
- 3 Output Side:
 - a Max Rated Output: 22 kW,30kW
 - b Rated current: 33A,45A
 - c Max efficiency: 98.2%
 - d Power factor: 0.995
- 4 Dimensions: 1061x702x292mm
- 5 Cooling: Natural
- 6 Environmental protection rating: IP65
- 7 Isolation level: Transformerless
- 8 Construction standard: ENA ER G59
- 9 Data logger: with BMS interface for remote monitoring

D Type TP4- 33 kW Transformerless inverters designed for medium and large scale (MW) decentralised PV systems roof top mounted or ground mounted. Unit complete with MPP tracker built in string combiner box, DC switch, string current monitoring with alarm, PV fuses, monitored surge protection devices and tool-less quick solar connectors.

- 1 Available model sizes: 33kW.
- 2 Input Side:
 - a Max PV Generator power: 33.7kW
 - b MPP range: 580v to 850V
 - c Starting voltage: 610V
 - d Max Input current: 58A,
 - e No MPP trackers: 1
 - f Max Power/tracker: 33kW
- 3 Output Side:
 - a Rated Output: 33kVA;
 - b Rated current: 50.3A;
 - c Max efficiency: 98.3%
 - d Power factor: 0.995
- 4 Dimensions: 740x520x300mm
- 5 Cooling: Fan Cooled
- 6 Environmental protection rating: IP54
- 7 Isolation level: Transformerless
- 8 Construction standard: ENA ER G59
- 9 Data logger: with BMS interface for remote monitoring

E Type TP5- Three Phase String Inverters: 30-60kW; Transformerless three phase inverter for decentralised installation of photovoltaic cells. Unit complete with 3 separate MPP trackers, built in string combiner box, DC switch, string current monitoring with alarm, PV fuses and monitored surge protection devices.

- 1 Available model sizes: 30kW; 33kW;36kW; 39kW;60kW. Characteristics for each model are indicated only where they are different.
- 2 Input Side:
 - a Max PV Generator power: 30kW; 33kW;36kW; 39kW;60kW
 - b MPP range: 200v to 800V
 - c Starting voltage: 250V
 - d Max Input current: 3x34A, 3x34A,3x34A,3x34A,3x36A
 - e No MPP trackers: 3
 - f Max Power/tracker: 20kW
- 3 Output Side:
 - a Rated Output: 25kVA;27.5kVA;30kVA;33.3kVA;49.9kVA
 - b Rated current: 3x36.2A;3x39.9A;3x43.5A;3x48.3;3x72.2
 - c Max efficiency: 98%

- d Power factor: 0.8
- 4 Dimensions: 1360x840x355mm
- 5 Cooling: Fan Cooled
- 6 Environmental protection rating: IP54
- 7 Isolation level: Transformer-less
- 8 Construction standard: ENA ER G59
- 9 Data logger: with BMS interface for remote monitoring

V14.2.9 GENERATION METER

- A Provide an inverter output meter for each inverter to display and record the energy delivered by the PV system (kWh) together with the instantaneous power output kWe.
- B Where power is exported to the grid provide an export meter approved by DNO.

V14.2.10 CONTROL AND PROTECTION

- A Provide a micro-computer-based control, protection and monitoring system. The control system should permit continuous operation within the safety and operational limits of the installed package.

V14.3 PART 3 – EXECUTION

V14.3.1 EXAMINATION

- A Examine areas, equipment bases, and conditions, for compliance with requirements for installation and other conditions affecting solar collector installation and performance.
- B Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before solar collector installation.
- C Proceed with installation only after unsatisfactory conditions have been corrected.
- D Ensure that the solar installation does not compromise the fire performance of the roof.
- E Ensure that the installation does not reduce the weather tightness of the roof
 - 1 any conduits, collectors, or fixings that penetrate the roof should be properly weather protected to prevent the ingress of rainwater or dampness, using flashings;
 - 2 any conduits or fixings that penetrate an external wall should be properly weather protected to prevent the ingress of rainwater or dampness, for instance by caulking small gaps around pipes;
 - 3 conduits or fixings that penetrate an external wall should be installed in a way that does not adversely affect any existing damp proof, waterproof or breather membranes: if a membrane is damaged or disturbed, it should be reinstated.
- F For photovoltaic systems care should be taken, as with any electrical installation, to avoid risks of electrocution and fire.

V14.3.2 PHOTVOLTAIC INSTALLATION

- A The installation must be carried out by competent installers with approved qualifications able to apply safe methods of work to install a SSEG. Installer should be member of the Electrical Contractors Association
- B Ensure that measures are taken to provide safe working conditions and protect against electric shock
- C External cables should be UV stable and water resistant. Ensure that cables can accommodate movement due to thermal or wind effects.
- D Ensure that cables are protected against mechanical damage by use of metallic trunking or use of steel wired armoured cable.
- E Label cables every 8m with Danger notice with black lettering on yellow background saying:

DANGER
SOLAR PV
ARRAY CABLE
High Voltage DC
Live During Daylight

- F Where multiple PV sub-arrays and or string conductors enter a junction box they should be grouped or identified in pairs so that positive and negative conductors of the same circuit may easily be clearly distinguished from other pairs.

V14.3.3 PHOTOVOLTAIC INSTLLATION COMMISSIONING

- A For each SSEG give 28 days' notice to the CA and the DNO of your intention to commission the system and provide the following information in line with ER G83 or ERG59 as appropriate.
 - 1 Primary Energy Source

- 2 kW per phase
- 3 Circuit Diagram of the connection
- 4 SSEG Type reference number
- 5 SSEG Type:
- 6 Maximum rate capacity kW per phase
- 7 Power Quality.
 - a Harmonics
 - b Voltage Fluctuations and Flicker
 - c DC Injection
 - d Power Factor:
- 8 Protection:
 - a Frequency Tests:
 - b Voltage Tests:
 - c Loss of mains:
 - d Frequency changes, Stability test:
 - e Re-connection timer:
- 9 Fault Level Contribution:
- 10 Self-Monitoring solid state switching:

V14.3.4 PHOTOVOLTAIC HANDOVER & DOCUMENTATION

A The system user should be provided as a minimum with the information as described in of BS EN 62446 Grid connected photovoltaic systems — Minimum requirements for system documentation, commissioning tests and inspection. The following provides a summary of the information required:

- 1 Basic system information: Parts used, rated power, installation dates etc
- 2 System designer information
- 3 System installer information
- 4 Wiring diagram, to include information on:
 - a Module type & quantities
 - b String configurations
 - c Cable specifications – size and type.
 - d Over-current protective device specifications (where fitted) - type and ratings.
 - e Array junction box locations (where applicable).
 - f d.c. isolator type, location and rating
 - g Array over-current protective devices (where applicable) – type, location and rating
 - h Details of all earth / bonding conductors – size and connection points.
 - i Details of any connections to an existing Lightning Protection System (LPS).
 - j Details of any surge protection device installed (both on a.c. and d.c. lines) to include location, type and rating.
 - k AC isolator location, type and rating.
 - l AC overcurrent protective device location, type and rating.
 - m Residual current device location, type and rating (where fitted).
- 5 Module datasheets
- 6 Inverter datasheets
- 7 Mounting system datasheet
- 8 Operation and maintenance information, to include:
 - a Procedures for verifying correct system operation.
 - b A checklist of what to do in case of a system failure.
 - c Emergency shutdown / isolation procedures.
 - d Maintenance and cleaning recommendations (if any).
 - e Considerations for any future building works related to the PV array (e.g. roof works).
- 9 Warranty documentation for PV modules and inverters - to include starting date of warranty and period of warranty.

- 10 Documentation on any applicable workmanship or weather-tightness warranties.
- 11 Test results and commissioning data

V14.3.5 START-UP SERVICE

- A Engage a factory-authorized service representative to perform start-up service:
 - 1 Inspect field-assembled components, equipment installation, and electrical connections for proper assembly, installation, and connection.
 - 2 Prepare test and inspection start-up reports.

V14.3.6 DEMONSTRATION

- A Engage a factory-authorized service representative to train employer's maintenance personnel to adjust, operate, and maintain the photovoltaic installations.

V30 LOW VOLTAGE DISTRIBUTION SYSTEMS

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V30.1 PART 1 – GENERAL

V30.1.1 RELATED DOCUMENTS

- A Drawings and general provisions of the Contract, including main Contract Preliminaries and section A of this specification.
- B For system descriptions, operating parameters and ambient temperatures refer to section B of this specification and the Schedules of Equipment.
- C Refer also to the following sections:
 - 1 V31: Low Voltage Switchgear
 - 2 V80: Electrical Identification
 - 3 V81: Earthing and Bonding Systems
 - 4 Y41: Building Management Systems
 - 5 Y50: Electrical Commissioning
 - 6 Y60: Conduit and trunking
 - 7 Y61: LV & ELV Cables
 - 8 Y63: Cable Supports
 - 9 Y65: Electrical Accessories
 - 10 Y90: Fixing to Building.

V30.1.2 SUMMARY

- A This Section includes:
 - 1 Switch Disconnectors
 - 2 Fuse Combination Units
 - 3 Cabling and terminations.

V30.1.3 DEFINITIONS

- A Disconnecter: Is a mechanical switch which in the 'Open' position, complies with requirements specified for the isolating function. A 'Disconnecter' or 'Isolator' is an offload device and marked 'Isolate elsewhere before opening' they have an AC20/DC20 utilisation category.
- B Switch: Is a mechanical switching device capable of making, carrying and breaking current under normal circuit conditions, which may include specified operating overload conditions. They also carry, for a specified time, currents under specified abnormal circuit conditions, such as those of short circuit (i.e. Utilisation category AC23A duty).
- C Switch-Disconnecter: Meets both of these criteria and with a Red/Yellow padlockable handle and may also be called a 'Safety Isolator'.
- D Changeover device: Is used to connect to one of two sources, and in this isolation, application will require a central 'Off' position. In all other respects it conforms to the 'Switch-Disconnecter' requirements.
- E Fuse Combination Unit: Is a combination of a mechanical switching device with fuses in a composite assembly.
- F The following acronyms are used in this specification:
 - 1 A.C: Alternating Current
 - 2 D.C: Direct Current
 - 3 High Voltage (HV): Voltage $\geq 35\text{kV}$ but for this document also includes MV
 - 4 Medium Voltage (MV): Voltage $\geq 1.0\text{kV}$ and $\leq 35\text{kV}$ referred to as HV in this document
 - 5 Low Voltage (LV): Voltage

- a A.C: $\geq 50V$ and $\leq 1000V$ or $600V$ between conductors and earth
- b D.C: $1500V$ between conductors or $900V$ between conductors and Earth.
- 6 Extra Low Voltage (ELV):
 - a A.C: $<50V$
 - b D.C. $<120V$ ripple-free
- 7 XLPE: Crosslinked Polyethylene
- 8 LSF: Low Smoke and Fume
- 9 ATS: Automatic Transfer Switches
- 10 LEDC: Local Electrical Distribution Company
- 11 SCADA: Supervisory Control and Data Acquisition
- 12 MCC: Motor Control Centre
- 13 rh: relative humidity
- 14 ACB: Air Circuit Breaker
- 15 IP: Ingress Protection to BS EN 60529 and defines protection against solid objects and separately against moisture
- 16 ATEX: ATEX is the name given to a set of European Directives relating to Hazardous areas electrical equipment atmospheres
- 17 DSERA: Dangerous Substances and Explosive Atmospheres Regulations in response to the ATEX directives.

G Pollution Degree: As defined in IEC 60947-1. It is a conventional number based on the amount of conductive or hygroscopic dust, ionized gas or salt, and on the relative humidity and its frequency of occurrence resulting in hygroscopic absorption or condensation of moisture leading to reduction in dielectric strength and/or surface resistivity the environmental conditions for which the assembly is intended. For switching components inside an enclosure, the pollution degree are as follows:

- 1 Pollution degree 1: No pollution or only dry, non-conductive pollution occurs. The pollution has no influence
- 2 Pollution degree 2: Only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation is to be expected
- 3 Pollution degree 3: Conductive pollution occurs, or dry, non-conductive pollution occurs which is expected to become conductive due to condensation
- 4 Pollution degree 4: Continuous conductivity occurs due to conductive dust, rain or other wet conditions.

H Unless otherwise stated, ASSEMBLIES for industrial applications are generally for use in a pollution degree 3 environment. However, other pollution degrees may be considered to apply, depending upon particular applications or the micro-environment.

I Hazardous area: Defined by and all equipment should be selected to ensure that it is suitable for the particular environment into which it is being installed:

- 1 Type of Hazard:
 - a Group I: Electrical equipment for mines and underground installations susceptible to firedamp
 - b Group II: Electrical equipment for places with an explosive gas atmosphere with subdivisions depending upon ignition energy in μJ :
 - IIA: $260 \mu J$
 - IIB: $95 \mu J$
 - IIC: $18 \mu J$.
 - c Group III: Electrical equipment for places with an explosive dust atmosphere and sub-divided according to the nature of the explosive atmosphere
 - IIIA: Combustible Flyings
 - IIIB: Non-conductive dust
 - IIIC: Conductive dust
- 2 Auto-ignition temperature of hazardous material (temperature or T rating). The temperature class and ignition temperature is as follows for Group I & II gases:
 - a Group I: $T_1 >450^{\circ}C$

- b Group II: $T_2 > 300 \leq 450^\circ\text{C}$
- c Group II: $T_3 > 200 \leq 350^\circ\text{C}$
- d Group II: $T_4 > 130 \leq 200^\circ\text{C}$.
- 3 Auto-ignition temperature for flammable dusts and fibres:
 - a No equipment should be installed where the surface temperature of the equipment is greater than the ignition temperature of the given hazard.
 - b Assess the ignition temperature of the atmosphere and select equipment appropriately.
- 4 Hazardous area characteristics: For gases and dusts/fibres there are 3 zones:

Gas	Dust	Hazardous Area Characteristics
Zone 0	Zone 20	A hazardous atmosphere is highly likely to be present and may be present for long periods of time (>1000 hours per year) or even continuously
Zone 1	Zone 21	A hazardous atmosphere is possible but unlikely to be present for long periods of time (>10 <1000 hours per year)
Zone 2	Zone 22	A hazardous atmosphere is not likely to be present in normal operation or infrequently and for short periods of time (<10 hours per year)

J For Hazardous areas the protection concepts are defined as follows:

- 1 Ex i: Intrinsic Safety where electrical energy level is below that of ignition or surface temperature limited
 - a ia: allows 2 faults during operation
 - b ib: allows one fault during operation.
- 2 Ex d: Flameproof: where the enclosure prevents the hazardous atmosphere from getting in and equipment can withstand the force of an explosion and prevent transmission to outside of the enclosure
- 3 Ex m: Encapsulation: potentially explosive equipment contained in a compound or resin.
- 4 Ex e: Increased Safety: Equipment designed to avoid spark production and excessive temperatures
- 5 Ex p: Pressurised: Pressure inside the enclosure prevents hazardous atmosphere from entering it
- 6 Ex o: Oil immersion: Oil provides an insulation protection against arcing.
- 7 Ex q: Powder Filling: Powder filling provides an insulation against arcing.
- 8 Ex n: Arcing potential is not capable of igniting the hazardous atmosphere:
 - a Ex nA: components are non-sparking
 - b Ex nC: components are non-incendive
 - c Ex nR: components are installed tightly to restrict breathing/ignition
 - d Ex nL: Components do not contain enough energy to cause an explosion
- 9 EX s: Special: no specific parameters but provides a pre-determined level of safety.

V30.1.4 PERFORMANCE REQUIREMENTS

- A To provide a system for the distribution of LV circuits from the LV distribution panels, final circuit distribution panels and switch connect/disconnect devices (isolators) as indicated on the drawings and as required for safe maintenance of all equipment.
- B All switch disconnect devices shall be suitable for their application, rated for the fault level at the point in the installation at which they are connected and to break the appropriate load of the equipment (load break), unless otherwise stated.
- C Service Conditions: The following conditions apply for installations below 2000m. For higher altitudes take into account the reduction in dielectric strength, the switching capability of the devices and the cooling effect of the air:
 - 1 Indoor installations:
 - a Maximum air temperature/relative humidity: $+40^\circ\text{C}/50\% \text{ rh}$
 - b Average over 24h: $\leq +35^\circ\text{C}$
 - c Minimum temperature: -5°C

- d Humidity varies with temperature (max 90% at +20°C)
- e Pollution degree:
 - Commercial applications: Degree 2
 - Industrial applications: Degree 3.
- 2 Outdoor installations:
 - a Maximum air temperature: +40°C
 - b Average over 24h: $\leq +35^{\circ}\text{C}$
 - c Minimum temperature: -25°C
 - d Humidity: 100% at +25°C (varies with temperature)
 - e Pollution degree:
 - External applications: Degree 4
- 3 For special service conditions: refer to equipment schedules and section B of this specification. Special service conditions may include:
 - a Vibration
 - b Exceptional condensation
 - c Very heavy pollution
 - d Corrosive environment
 - e Strong magnetic fields
 - f Fungus
 - g Small creatures
 - h explosion hazards
 - i earthquakes.

V30.1.5 SUBMITTALS

- A Refer to Section A of this specification.
- B Product Data: For each type of switchgear, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- C Shop Drawings: For each type of switchgear and related equipment:
 - 1 Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:
 - a Tabulation of installed devices with features and ratings
 - b Enclosure types and details
 - c Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section
 - d Bus configuration with size and number of conductors in each bus run, including phase, neutral, and ground conductors of main and branch buses
 - e Current rating of buses
 - f Short-time and short-circuit current rating of switchgear assembly
 - g Nameplate legends
 - h Mimic-bus diagram
 - i Utility company's metering provisions with indication of approval by utility company.
 - j UL listing for series rating of installed devices
 - k Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components
 - 2 Wiring Diagrams: Power, signal, and control wiring.
- D Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around switchgear where piping and ducts are prohibited. Show component layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Identify field measurements.

- E Samples: Representative portion of mimic bus with specified finish. Manufacturer's colour charts showing colours available for mimic bus.
- F Qualification Data: For testing agency.
- G Field quality-control test reports.
- H Operation and Maintenance Data: For switchgear and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section A "Operation and Maintenance Data," include the following:
 - 1 Manufacturer's written instructions for testing and adjusting overcurrent protective devices
 - 2 Time-current curves, including selectable ranges for each type of overcurrent protective device.

V30.1.6 QUALITY ASSURANCE

- A Ensure that the design, construction, material and finishes of all component parts will be suitable for the local climatic and service operating conditions and as indicated in this specification and drawings.
- B Ensure that the whole installation complies with the relevant standards, including the following:
 - 1 BS 7671+A3 - Requirements for electrical installations. IET Wiring Regulations. Seventeenth edition
 - 2 BS EN 12101-3: Smoke and heat control systems. Specification for powered smoke and heat control ventilators (Fans)
 - 3 BS EN 60073: Basic and safety principles for man-machine interface, marking and identification. Coding principles for indicators and actuators
 - 4 BS EN 60079-0: +A1 Explosive atmospheres. Equipment. General requirements
 - 5 BS EN 60079-1: Explosive atmospheres. Equipment protection by flameproof enclosures "d"
 - 6 BS EN 60079-2: Explosive atmospheres. Equipment protection by pressurized enclosure "p"
 - 7 BS EN 60079-5: Explosive atmospheres. Equipment protection by powder filling "q"
 - 8 BS EN 60079-6: Explosive atmospheres. Equipment protection by liquid immersion "o"
 - 9 BS EN 60079-7: Explosive atmospheres. Equipment protection by increased safety "e"
 - 10 BS EN 60079-11: Explosive atmospheres. Equipment protection by intrinsic safety "i"
 - 11 BS EN 60079-13: Explosive atmospheres. Equipment protection by pressurized room "p"
 - 12 BS EN 60079-14: Explosive atmospheres. Electrical installations design, selection and erection
 - 13 BS EN 60079-15: Explosive atmospheres. Equipment protection by type of protection "n"
 - 14 BS EN 60079-17: Explosive atmospheres. Electrical installations inspection and maintenance
 - 15 BS EN 60079-18: Explosive atmospheres. Equipment protection by encapsulation "m"
 - 16 BS EN 60079-19: +A1: Explosive atmospheres. Equipment repair, overhaul and reclamation
 - 17 BS EN 60269-1: +A2, BS 88-1: +A2: Low-voltage fuses. General requirements
 - 18 BS EN 60079-31: Explosive atmospheres. Equipment dust ignition protection by enclosure "t"
 - 19 BS EN 60269-2, BS 88-2: Low-voltage fuses. Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application). Examples of standardized systems of fuses A to J
 - 20 BS EN 60269-4:2009+A1, BS 88-4:2009+A1: Low-voltage fuses. Supplementary requirements for fuse-links for the protection of semiconductor devices
 - 21 BS EN 60529 - Specification for degrees of protection provided by enclosures (IP code)
 - 22 BS EN 60898-1: +A13: Electrical accessories ± Circuit breakers for overcurrent protection for household and similar installations. Circuit-breakers for A.C. operation
 - 23 BS EN 60898-2: Electrical accessories. Circuit-breakers for overcurrent protection for household and similar installations. Circuit-breakers for A.C and D.C. operation
 - 24 BS EN 60947-1+A2: Low-voltage switchgear and controlgear. General rules
 - 25 BS EN 60947-2+A2: Low-voltage switchgear and controlgear. Circuit-breakers
 - 26 BS EN 60947-3+A2: Low-voltage switchgear and controlgear. Switches, disconnectors, switch-disconnectors and fuse-combination units
 - 27 BS EN 60947-4-3: Low-voltage switchgear and controlgear. Contactors and motor-starters. AC semiconductor controllers and contactors for non-motor loads

- 28 BS EN 60947-5-5: +A11: IEC 60947-5-5: Low-voltage switchgear and controlgear. Control circuit devices and switching elements. Electrical emergency stop device with mechanical latching function
- 29 BS EN 60947-6-1: +A1: Low-voltage switchgear and controlgear. Multiple function equipment. Transfer switching equipment
- 30 BS EN 60947-7-1: Low-voltage switchgear and controlgear. Ancillary equipment. Terminal blocks for copper conductors
- 31 BS EN 60947-7-2: Low-voltage switchgear and controlgear. Ancillary equipment. Protective conductor terminal blocks for copper conductors
- 32 BS EN 60947-7-3: Low-voltage switchgear and controlgear. Ancillary equipment. Safety requirements for fuse terminal blocks
- 33 BS EN 60947-7-4: Low-voltage switchgear and controlgear. Ancillary equipment. PCB terminal blocks for copper conductors
- 34 BS EN 60947-8: +A2: Low-voltage switchgear and controlgear. Control units for built-in thermal protection (PTC) for rotating electrical machines
- 35 BS EN 61008-1: +A11: Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs). General rules
- 36 BS EN 61008-2-1: Specification for residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs). Applicability of the general rules to RCCBs functionally independent of line voltage
- 37 BS EN 61241-2-2: Electrical apparatus for use in the presence of combustible dust. Test methods. Method for determining the electrical resistivity of dust in layers
- 38 BS EN 61439-1: Low-voltage switchgear and controlgear assemblies. General rules
- 39 BS EN 61439-2: Low-voltage switchgear and controlgear assemblies. Power switchgear and controlgear assemblies.

- C Source Limitations: Obtain each component through one source from a single manufacturer wherever possible.
- D Product Options: Drawings indicate size, profiles, and dimensional requirements of components and are based on the specific system indicated.
- E Electrical Components, Devices, and Accessories: Shall be listed and labelled as defined in Local Wiring regulations, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F The components shall meet the recommendations given in the latest editions of the applicable standards.

V30.1.7 DELIVERY, STORAGE, AND HANDLING

- A Deliver in sections of lengths that can be moved past obstructions in delivery path as indicated.
- B Store components indoors in clean dry space with uniform temperature to prevent condensation. Protect components from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- C If stored in areas subjected to weather, cover components to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside components; install electric heating (250 W per section) to prevent condensation.
- D Installation Pathway: Review Architects drawings and Structural engineer's drawings to understand pathway for moving components into place:
 - 1 Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated
 - 2 Do not proceed with interruption of electrical service without [Architect's] [Construction Manager's] [Owner's] written permission.

V30.1.8 COORDINATION

- A Coordinate layout and installation of components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.
- B Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements.

V30.2 PART 2 - PRODUCTS

V30.2.1 LV ASSEMBLIES GENERAL

- A Construct LV assemblies of materials capable of withstanding the mechanical, electrical, thermal and environmental stresses that are likely to be encountered in specified service conditions.
- B Provide protection against corrosion.
- C For external assemblies provide protection against ingress of water and from ultra-violet radiation.
- D Ensure all equipment is suitable for the environment into which it is to be used.

V30.2.2 SWITCH DISCONNECTORS AND FUSE COMBINATION UNITS GENERAL

- A Provide switch disconnectors and fuse combination units where specified and as indicated on the drawings and schedules. Switch Disconnectors provide the means to safely disconnect an item of electrical equipment from the supply. Primarily designed to provide a means of local isolation when an electrical item may need maintenance or repair. It should provide the following minimum requirements:
 - 1 An effective clearance between the supply and the load appropriate to the voltage applied
 - 2 A means of locking in the 'Off' position. (Padlocking)
 - 3 A true indication of the contact state
 - 4 A safe disconnection from the supply even under fault conditions.
- B Ensure double pole and triple pole and neutral control switches are in accordance with relevant Standards (BS EN 60947-3) and are matched with other accessories defined in the Specification. Switching devices are classified according to Utilisation Category as detailed in the table below. Select devices appropriate to the intended utilisation category:
- C In the table below frequent use and infrequent use have the following definitions:
 - 1 Frequent Use (A): Up to 5 times a day for loads up to 100A, once a week for larger loads
 - 2 Infrequent Use (B): Once a week for smaller devices (up to 100A), once a month for larger devices.

Table of Utilisation Categories

Utilisation Category		Typical Applications	Cos Ø	Making Current x In	Breaking Current x In
Frequent Operations (A)	Infrequent Operations (B)		Power Factor		
AC-20A	AC-20B	Connecting and disconnecting under no-load conditions	-	-	-
AC-21A	AC-21B	Switching of resistive loads including moderate overloads	0.95	1.5	1.5
AC-22A	AC-22B	Switching of mixed resistive and inductive loads including moderate overloads	0.65	3	3
AC-23A	AC-23B	Switching of motor loads or other highly inductive loads	0.45 for $I \leq 100A$	10	8

- D Available Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - 1 Craig & Derricott

- 2 MEM
- 3 Merlin Gerin
- 4 Schneider Electric

V30.2.3 MOULDED CASE ROTARY SWITCH DISCONNECTORS

- A Applications: Rotary switch type for indoor surface mounting suitable for most commercial and assembly industrial applications where a high degree of robustness is not required.
- B Construction: Moulded plastic enclosure having a choice of neutral assemblies.
- 1 Ratings and Format: as indicated on the drawings:
 - a 20A: 6P
 - b 25A: 2P, 3P, 3P+NL, 3P+N
 - c 32A: 2P, 3P, 3P+NL, 3P+N
 - d 40A: 2P, 3P, 3P+NL, 3P+N, 6P
 - e 63A: 2P, 3P, 3P+NL, 3P+N
 - f 80A: 2P, 3P, 3P+NL, 3P+N
 - g 100A: 2P, 3P, 3P+NL, 3P+N.
 - 2 Format: As indicated on the drawings
 - a Neutrals:
 - + N: switched neutral (Early make, late break)
 - + NL: Unswitched neutral.
 - 3 Manufacture: BSEN 60947-3
 - 4 Enclosure IP rating: IP65
 - 5 Utilisation category: up to AC23
 - 6 Material: Polycarbonate/ABS plastic.
- C Provide the following features:
- 1 Operating Handle: Rotary type with padlock provision in the "Off" position preventing isolator being switched to the "On" position
 - 2 Contacts: Ensure contacts have a positive contact indication in the OPEN and CLOSED positions.
 - 3 Live terminals fully shrouded
 - 4 Mechanical interlock which prevents lid from being removed when padlocks are inserted
 - 5 Removable gland plates with cable knock outs.

V30.2.4 DIE-CAST ALUMINIUM ROTARY SWITCH DISCONNECTORS

- A Applications: Rotary switch type for indoor surface mounting for most commercial and industrial applications where a degree of robustness and resistance to impact is a concern. Use for plantroom applications and manufacturing areas in light industrial factories. Optional start/stop button facility.
- B Construction: Die-cast aluminium having a choice of neutral assemblies:
- 1 Ratings and Format: as indicated on the drawings:
 - a 20A: 2P, 3P, 4P
 - b 32A: 2P, 3P, 4P
 - c 40A: 2P, 3P, 4P
 - d 63A: 2P, 3P, 4P
 - 2 Neutrals: Options
 - + N: switched neutral (Early make, late break)
 - + NL: Unswitched neutral
 - 3 Manufacture: BSEN 60947-3
 - 4 Enclosure IP rating: IP66
 - 5 Utilisation category: up to AC23
 - 6 Material: Polycarbonate/ABS plastic.

- C Provide the following features:
- 1 Operating Handle: Rotary type with padlock provision in the "Off" position preventing isolator being switched to the "On" position
 - 2 Contacts: Ensure contacts have a positive contact indication in the OPEN and CLOSED positions.
 - 3 Live terminals fully shrouded
 - 4 Mechanical interlock which prevents lid from being removed when padlocks are inserted
 - 5 Removable gland plates with cable knock outs
 - 6 Start/Stop Emergency stop: provide if indicated on the drawings.

V30.2.5 SURFACE MOUNTING STAINLESS STEEL ROTARY SWITCH DISCONNECTORS

- A Applications: Rotary switch type for outdoor surface mounting. Use for outdoor unprotected locations or indoor subject to severe environmental conditions.
- B Construction: Epoxy powder coated sheet steel having a choice of neutral assemblies.
- 2 Ratings and Format: as indicated on the drawings:
 - a 20A: 6P
 - b 25A: 2P, 3P, 3P+NL, 3P+N
 - c 32A: 2P, 3P, 3P+NL, 3P+N
 - d 40A: 2P, 3P, 3P+NL, 3P+N, 6P
 - e 63A: 2P, 3P, 3P+NL, 3P+N
 - 3 Neutrals: Options
 - + N: switched neutral (Early make, late break)
 - + NL: Unswitched neutral.
 - 4 Manufacture: BSEN 60947-3
 - 5 Enclosure IP rating: IP66
 - 6 Utilisation category: up to AC23
 - 7 Material: 1.2mm stainless steel grade 304.
- B Provide the following features:
- 1 Operating Handle: Rotary type with padlock provision in the "Off" position preventing isolator being switched to the "On" position
 - 2 Contacts: Ensure contacts have a positive contact indication in the OPEN and CLOSED positions.
 - 3 Live terminals fully shrouded
 - 4 Mechanical interlock which prevents lid from being removed when padlocks are inserted
 - 5 Removable gland plates with cable knock outs.

V30.2.6 FLUSH WALL MOUNTING STAINLESS STEEL ROTARY SWITCH DISCONNECTORS

- A Applications: Rotary switch type for flush mounting for most indoor commercial and laboratory applications where a flush finish and quality finish is required. Use for kitchens, laboratories, food processing areas, hospitals and pharmaceutical manufacturing areas.
- B Construction: Brushed stainless steel face plate and zinc plated steel back box.
- 1 Ratings and Format: as indicated on the drawings:
 - a 20A: 6P
 - b 25A: 2P, 3P, 3P+NL, 3P+N
 - c 32A: 2P, 3P, 3P+NL, 3P+N
 - d 40A: 2P, 3P, 3P+NL, 3P+N, 6P
 - e 63A: 2P, 3P, 3P+NL, 3P+N, 6P
 - f 80A: 2P, 3P, 3P+NL, 3P+N.
 - 2 Manufacture: BSEN 60947-3
 - 3 Enclosure IP rating: IP66

- 4 Utilisation category: up to AC23
- 5 Material:
 - a Fascia Plate: 304 Stainless steel 1.2mm
 - b Back Box: 1.4mm galvanised sheet steel.

C Provide the following features:

- 1 Operating Handle: Rotary type with padlock provision in the "Off" position preventing isolator being switched to the "On" position
- 2 Contacts: Ensure contacts have a positive contact indication in the OPEN and CLOSED positions.
- 3 Live terminals fully shrouded
- 4 Mechanical interlock which prevents lid from being removed when padlocks are inserted
- 5 Removable gland plates with cable knock outs.

V30.2.7 MILD STEEL ROTARY SWITCH DISCONNECTORS

A Applications: Rotary switch type for indoor surface mounting for most heavy industrial applications where a high degree of robustness and resistance to impact is a concern. Use for manufacturing areas in heavy industry factories.

B Construction: Epoxy powder coated sheet steel having a choice of neutral assemblies.

- 1 Ratings and Format: as indicated on the drawings:
 - a 20A: 6P
 - b 25A: 2P, 3P, 3P+NL, 3P+N
 - c 32A: 2P, 3P, 3P+NL, 3P+N
 - d 40A: 2P, 3P, 3P+NL, 3P+N, 6P
 - e 63A: 2P, 3P, 3P+NL, 3P+N
- 2 Neutrals: Options:
 - + N: switched neutral (Early make, late break)
 - + NL: Unswitched neutral.
- 3 Manufacture: BSEN 60947-3
- 4 Enclosure IP rating: IP66
- 5 Utilisation category: up to AC23
- 6 Material: 1.2mm epoxy coated sheet steel.

B Provide the following features:

- 6 Operating Handle: Rotary type with padlock provision in the "Off" position preventing isolator being switched to the "On" position
- 7 Contacts: Ensure contacts have a positive contact indication in the OPEN and CLOSED positions.
- 8 Live terminals fully shrouded
- 9 Mechanical interlock which prevents lid from being removed when padlocks are inserted
- 10 Removable gland plates with cable knock outs.

V30.1.2 FUSE COMBINATION UNIT/ HINGED DOOR SWITCH DISCONNECTORS

A Applications: Fuse combination/hinged door switch disconnectors. Suitable for most indoor industrial applications. Use as follows and where indicated on the drawings:

- a Switch Disconnectors: For larger loads greater than 80A
- b Fuse Combination Units: For loads 32A-630A.

B Construction: Grey coated sheet steel enclosure having a choice of neutral assemblies:

- 1 Switch Disconnector Ratings and Format: as indicated on the drawings:
 - c 100A: 3P+N, 3P+NL
 - d 125A: 3P+N, 3P+NL

- e 160A: 3P+N,3P+NL
 - f 200A: 3P+N,3P+NL
 - g 250A: 3P+N,3P+NL
 - h 400A: 3P+N,3P+NL
 - i 630A: 3P+N,3P+NL
 - j 800A: 3P+N,3P+NL
 - k 1000A: 3P+N,3P+NL.
- 2 Fuse Combination Units Ratings and Format as indicated on the drawings:
- a 32A: 3P+N
 - b 63A: 3P+N
 - c 100A:3P+N
 - d 125A: 3P+N
 - e 160A: 3P+N
 - f 200A: 3P+N
 - g 250A: 3P+N
 - h 315A: 3P+N
 - i 400A: 3P+N
 - j 630A: 3P+N.
- 3 Neutrals: Options:
- + N: switched neutral (Early make, late break)
 - + NL: Unswitched neutral (100% rated 32-200A, 50% rated 250-1000A)
- 4 Manufacture: BSEN 60947-3
- 5 Enclosure IP rating: IP41or IP65 depending upon location
- 6 Utilisation category: up to AC23
- 7 Material:
- a Grey powder coated sheet steel (normal environments)
 - b Stainless steel: Use for severe environments.

C Provide the following features:

- 1 Operating Handle: Door interlocked lever type with padlock provision in the "Off" and "ON" positions
- 2 Contacts: Ensure contacts have a positive contact indication in the OPEN and CLOSED positions.
- 3 Live terminals fully shrouded
- 4 Removable gland plates with cable knock outs
- 5 Manufacture: BSEN 60947-3
- 6 Utilisation category: up to AC23
- 7 Castell locks: Option to provide where indicated.

D For fuse combination units provide the following additional features:

- 1 Fuse links: HRC and comply with BS88, or BSEN 60269
- 2 AC Interrupting medium: Air
- 3 Fuse switches: 3 pole type with bolted neutral
- 4 Contacts: Quick make and quick break type ensuring full contact pressure until time of opening, when actuated manually
- 6 Interlock: to prevent access to the fuse when the switch is ON
- 7 Double isolation: Upstream and downstream of the fuse link when the switch is OFF.

V30.1.3 FIRE RATED SWITCH DISCONNECTORS

A Applications: Fire rated switch disconnectors. Use where life safety, smoke control or firefighting equipment is provided. Typical applications include car park ventilation systems, stair well pressurisation systems, sprinkler and firefighting pumps. Use as follows and where indicated on the drawings:

- 1 F400 Switch Disconnectors: Where supply must be maintained for 120 minutes at 400°C
- 5 F300 Switch Disconnectors: Where supply must be maintained for 60 minutes at 300°C

6 F200 Switch Disconnectors: Where supply must be maintained for 120 minutes at 200°C:

B Construction: Red coated (RAL 3020) enclosure having a choice of neutral assemblies. Fixed lid or hinged door enclosure:

- 1 Lid mounted: Die-cast aluminium or sheet steel enclosure
- 2 Base mounted: Hinged door sheet steel enclosure
- 3 Standard: BS EN 12101-3
- 4 Switch Disconnector Ratings and Format: as indicated on the drawings:
 - a F400:
 - 20A: 2P,3P,3P+N,4P,6P
 - 32A: 2P,3P,3P+N,4P,6P
 - 63A: 2P,3P,3P+N,4P,6P
 - 125A: 2P,3P,3P+N,4P,6P.
 - b F300:
 - 160A: 3P,3P+N,4P,6P, 6P+NL
 - 200A: 3P,3P+N,4P,6P, 6P+NL
 - 250A: 3P,3P+N,4P,6P, 6P+NL
 - 315A: 3P,3P+N,4P,6P, 6P+NL
 - 400A: 3P,3P+N,4P,6P, 6P+NL
 - 630A: 3P,3P+N,4P,6P, 6P+NL.
 - c F200:
 - 20A: 6P
 - 25A: 2P,3P,3P+N,3P+NL
 - 32A: 2P,3P,3P+N,3P+NL
 - 40A: 2P,3P,3P+N,3P+NL,6P
 - 63A: 2P,3P,3P+N,3P+NL
 - 80A: 3P,3P+N,3P+NL
 - 100A: 3P+N,3P+NL
 - 125A: 3P+N,3P+NL
 - 160A: 3P+N,3P+NL
 - 200A: 3P+N,3P+NL.
- 7 Neutrals: Options:
 - + N: switched neutral (Early make, late break)
 - + NL: Unswitched neutral (100% rated 32-200A, 50% rated 250-1000A).
- 8 Manufacture: BSEN 60947-3
- 9 Enclosure IP rating: IP65
- 10 Utilisation category: up to AC23
- 11 Material:
 - a Red powder coated sheet steel or die-cast aluminium.

E Provide the following features:

- 1 Operating Handle: Rotary switch or Door interlocked lever type with padlock provision in the "Off" and "ON" positions
- 2 Contacts: Ensure contacts have a positive contact indication in the OPEN and CLOSED positions.
- 3 Live terminals fully shrouded
- 4 Removable gland plates with cable knock outs
- 5 Manufacture: BSEN 60947-3
- 6 Castell locks: Option to provide where indicated.

V30.2.8 EQUIPMENT FOR HAZARDOUS ENVIRONMENTS GENERAL

A Hazardous places are classified in terms of zones on the basis of the frequency and duration of the occurrence of an explosive atmosphere as defined in BS EN 60079/10 and BS EN 61241/3 and now

embodied in Dangerous substances and Explosive Atmosphere Regulations (DSEAR) in response to the ATEX directives:

- 1 Gases, vapours and mists: For gases, vapours and mists the zone classifications are:
 - a Zone 0
 - b Zone 1
 - c Zone 2.
- 2 Dusts: For dusts the zone classifications are:
 - a Zone 20
 - b Zone 21
 - c Zone 22.
 - d Notes:
 - Layers, deposits and heaps of combustible dust must be considered as any other source which can form an explosive atmosphere
 - "Normal operation" means the situation when installations are used within their design parameters.

B Ensure that any equipment installed within hazardous places complies with BS EN 60079-14 and complies with the following categories of protection:

- 1 Zone 0 or zone 20: category 1 equipment
- 2 Zone 1 or zone 21: category 2 equipment
- 3 Zone 2 or zone 22: category 3 equipment.
- 4 Notes:
 - a Category 1 equipment can also be used in zones 1 and 21
 - b Category 1 and 2 equipment can be used in zones 2 and 22.

Type of Protection Method	Equipment Code	Protection Description	International Standard	Suitable for Zones
Intended to prevent a potential ignition arising	Ex e	Increased safety	BS EN 60079-7	1,2
	Ex nA	Type- n protection	BS EN 60079-15	2
Intended to limit the ignition energy of the equipment	Ex ia	Intrinsic safety 'ia'	BS EN 60079-11	0,1,2
	Ex ib	Intrinsic safety 'ib'	BS EN 60079-11	1,2
	Ex ic	Intrinsic safety 'ic'	BS EN 60079-11	2
	Ex nL	Type- n protection	BS EN 60079-15	2
Intended to prevent the explosive atmosphere contacting the ignition source	Ex p	Purge/pressurised	BS EN 60079-2	1,2
	Ex px	Purge/pressurised 'px'	BS EN 60079-2	1,2
	Ex py	Purge/pressurised 'py'	BS EN 60079-2	1,2
	Ex pz	Purge/pressurised 'pz'	BS EN 60079-2	2
	Ex m	Encapsulation	BS EN 60079-18	0,1,2
	Ex ma	Encapsulation	BS EN 60079-18	1,2
	Ex mb	Encapsulation	BS EN 60079-18	1,2
	Ex o	Oil Immersion	BS EN 60079-6	1,2
	Ex nR	Type- n protection	BS EN 60079-15	2
Intended to prevent an ignition from escaping outside the equipment	Ex d	Flameproof	BS EN 60079-1	1,2
	Ex q	Sand/powder (quartz) filling	BS EN 60079-5	1,2
	Ex nC	Type- n protection	BS EN 60079-15	2
Special	Ex s	Special protection	BS EN 60079-0	0,1,2

V30.2.9 ATEX FLAMEPROOF (Ex d) SWITCH DISCONNECTORS ZONES 1 ,2, 21 ,22

A Flameproof Switch disconnectors contained in heavy duty cast enclosures supplied pre-drilled materials suitable for use in Cat II, Zones 1, 2,21 &22 environments

B Construction:

- 1 Enclosure:
 - a 16A-80A: Cast iron
 - b 63A-250A: Aluminium
- 2 Finish: two pack epoxy coating grey
- 3 Utilisation rating: AC23A
- 4 Manufacture; BS EN 60947-3
- 5 Aux contacts for SCADA.

C Ratings and Format:

- 1 25A: 3P + N +2E/B
- 2 40A: 3P + N +2E/B, 6P +2E/B
- 3 63A: 3P + N +2E/B
- 4 80A: 3P + N +2E/B
- 5 100A: 3P + N +2E/B
- 6 125A: 3P + N +2E/B
- 7 160A: 3P + N +2E/B
- 8 200A: 3P + N +2E/B

9 250A: 3P + N + 2E/B.

D Certifications and Approvals:

- 1 Certification Code: ATEX Certified
 - a Ex d II 2 GD Ex IB T6
 - b Ex tD A21.
- 2 Certification Standard: BS EN 60079-0, -1, BS EN 61241-0,-1
- 3 Operating temperature: -20°C to +40°C
- 4 Ingress Protection: IP65.

E Provide the following features:

- 1 Operating Handle:
 - a Up to 40A: Rotary type with padlock provision in the "Off" position preventing isolator being switched to the "On" position
 - b >40A: Hinged Door interlocked lever type with padlock provision in the "Off" and "ON" positions
- 2 Contacts: Ensure contacts have a positive contact indication in the OPEN and CLOSED positions
- 2 Live terminals fully shrouded
- 3 Mechanical interlock which prevents lid from being removed when padlocks are inserted
- 4 Removable gland plates with cable knock outs.

V30.2.10 ATEX INCREASED SAFETY (Ex e) SWITCH DISCONNECTORS ZONES 1 ,2, 21, & 22

A Increased safety switch disconnectors contained in pre-drilled enclosures with lockable operating handles suitable for use in, Zones 1, 2,21 & 22 environments.

B Construction:

- 1 Enclosure: Glass reinforced polyester
- 2 Finish: Black
- 3 Utilisation rating: AC23A
- 4 Manufacture; BS EN 60947-3
- 5 Ambient Temperature: ≤ 40°C.

C Ratings and Format:

- 1 25A: 3P + Aux, 4P +Aux
- 2 40A: 3P + Aux, 4P +Aux
- 3 80A: 3P + Aux, 4P +Aux
- 4 180A: 3P + Aux, 4P +Aux.

D Certifications and Approvals:

- 1 Certification Code: ATEX certified:
 - a 25A, 40A, 80A:
 - Ex d e IIC T6 Gb,
 - Ex tb IIIC T80°C Db.
 - b 180A:
 - Ex d e IIC T5 Gb,
 - Ex tb IIIC T95°C Db.
 - c Certification Standard: BS EN 60079-0, -1, BS EN 61241-0,-1.
- 2 Operating temperature: -20°C to +40°C
- 3 Ingress Protection: IP65.

E Provide the following features:

- 1 Operating Handle:
 - a Up to 80A: Rotary type with padlock provision in the "Off" position preventing isolator being switched to the "On" position.

- 3 Contacts: Ensure contacts have a positive contact indication in the OPEN and CLOSED positions
- 2 Live terminals fully shrouded
- 3 Mechanical interlock which prevents lid from being removed when padlocks are inserted
- 4 Removable gland plates with cable knock outs

V30.2.11 ATEX NON-CONDUCTIVE DUST (Ex Zone 22) SWITCH DISCONNECTORS

- A ATEX zone 22 (Category 3D) non-conductive dust Increased safety switch disconnectors contained in pre-drilled enclosures with lockable operating handles. Must not be used in areas that exhibit conductive dusts.
- B Construction:
- 1 Enclosure:
 - a ≤40A: Die Cast Aluminium fixed lid
 - b >40A: Sheet steel hinged door type
 - 2 Finish:
 - a two pack epoxy coating grey
 - 3 Utilisation rating: AC23A
 - 4 Manufacture; BS EN 60947-3
 - 5 Ambient Temperature: ≤ 40°C.
- C Ratings and Format:
- 1 20A: 6P + 2 EB Aux
 - 2 25A: 3P +2EB Aux,
 - 3 32A: 3P +2EB Aux, 6P + 2 EB Aux
 - 4 40A: 3P +2EB Aux, 6P + 2 EB Aux
 - 5 63A: 3P +2EB Aux, 6P + 2 EB Aux.
- D Certifications and Approvals:
- 1 Certification Code: ATEX certified
 - a II 3D
 - b Tc IIIB T85°C Dc.
 - 2 Certification Standard: BS EN 60079-0, -1, BS EN 60079-31
 - 3 Operating temperature: -20°C to +40°C
 - 4 Ingress Protection: IP65.
- E Provide the following features:
- 1 Operating Handle:
 - a Up to 40A: Rotary type with padlock provision in the "Off" position preventing isolator being switched to the "On" position
 - b >40A: Hinged Door interlocked lever type with padlock provision in the "Off" and "ON" positions.
 - 2 Contacts: Ensure contacts have a positive contact indication in the OPEN and CLOSED positions.
 - 3 Live terminals fully shrouded
 - 2 Mechanical interlock which prevents lid from being removed when padlocks are inserted
 - 3 Removable gland plates with cable knock outs.

V30.2.12 EMERGENCY POWER OFF (EPO)CONTROL STATIONS

- A Application: Use where indicated on the drawings to provide isolation of the power supply to equipment in plantrooms, workshops and computer suites. It is intended, in an emergency, to power down a single piece of equipment or a complete system from a single point. Also, for use with UPS systems. To avoid accidental operation the buttons are protected with a flap guard. Two types are available:
- 1 Heavy Duty: For industrial or plantroom locations
 - 2 Normal Duty: For commercial applications

V30.2.13 HEAVY DUTY EMERGENCY POWER OFF (EPO)

- A Heavy duty EPOs use in industrial or plantroom situations to protect personnel in an emergency situation when it is necessary to safely remove power from a piece of equipment or system. Provide where indicated on the drawings.
- B Construction:
- 1 Enclosure:
 - a Casing: Die Cast Aluminium
 - b Push button Actuator: Pull to re-set type
 - c Non-locking die-cast flap cover to prevent accidental operation
 - 2 Finish:
 - a two pack epoxy coating grey with red printed flap cover
 - 3 Utilisation rating: AC15
 - 4 Manufacture; BS EN 60947-5-1
 - 5 Ingress of protection: IP 65
 - 6 Ambient Temperature: $\leq 40^{\circ}\text{C}$
 - 7 Ratings: as indicated on the drawings
 - a Up to 4 changeover contacts.

V30.2.14 NORMAL DUTY EMERGENCY POWER OFF (EPO)

- A Normal duty EPOs use for commercial installations to protect personnel in an emergency situation when it is necessary to safely remove power from a piece of equipment or system. Provide where indicated on the drawings.
- B Construction:
- 1 Enclosure:
 - a Casing: Die-cast aluminium
 - b Push button: Twist to re-set type
 - c Non-locking flap cover to prevent accidental operation.
 - 2 Finish:
 - a grey with red printed flap cover
 - 3 Utilisation rating: AC15
 - 4 Manufacture; BS EN 60947-5-1
 - 5 Ingress of Protection: IP 65
 - 6 Ambient Temperature: $\leq 40^{\circ}\text{C}$
 - 7 Ratings: as indicated on the drawings
 - a contacts: 1 normally open + 1 normally closed contact block.

V30.3 PART 3 - EXECUTION

V30.3.1 EXAMINATION

- A Examine elements and surfaces where switchgear will be installed for compliance with installation tolerances, required clearances, and other conditions affecting performance:
 - 1 Proceed with installation only after unsatisfactory conditions have been corrected.
- B Ensure that clearance in front of switchboards is not less than 1.2m, or as indicated.

V30.3.2 DISCONNECTORS AND FUSED SWITCH INSTALLATION

- A Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B Mount single items of equipment 1450mm above finished floor level to centre of equipment, unless shown otherwise on drawings/schedules.
- C Arrange groups of equipment, other than floor mounted assemblies, so that all parts of equipment requiring access for operation or maintenance are at least 500mm and no more than 2000mm above finished floor level, unless shown otherwise on drawings/schedules

V30.3.3 EPO INSTALLATION

- A Locate EPO in the positions indicated on the drawings. Do not locate in areas where they could be prone to being accidentally knocked.
- B Ensure that warning signs are provided and that the isolators are correctly labelled.

V30.3.4 CABLE/CONDUIT/TRUNKING SYSTEMS

- A For installation details refer to:
 - 1 Y60: Conduit and Trunking
 - 2 Y61: LV and ELV Cables
 - 3 Y63: Cable Support.

Y71.1.1 INSPECTION

- A The installer must examine the areas and conditions under which individual wall mounted components are to be installed. Ensure that they are correctly supplied and installed for the environment into which they are located.
- B Advise the Project Manager of any detriment and correct if it is the responsibility of the installer. Do not proceed with the work until unsatisfactory conditions have been corrected.

V30.3.5 IDENTIFICATION

- A Comply with the requirements of V80 "Electrical Identification":
 - 1 Identify field-installed conductors, interconnecting wiring, and components and provide warning signs
 - 2 Label each enclosure with engraved metal or laminated-plastic nameplate.

V30.3.6 CONNECTIONS

- A Earth equipment according to V81 "Earthing and Bonding Systems".

- B Connect wiring according to Y61 "LV and ELV Cables".

V30.3.7 FIELD QUALITY CONTROL

- A All electrical systems are to be tested in accordance with Y50 "Testing and Commissioning of Mechanical and Electrical Services"
- B Prepare test results and provide for witness acceptance.

V30.3.8 ADJUSTING

- A Set field-adjustable, protective-relay trip characteristics according to results in V31 "Low Voltage Switchgear".

V30.3.9 CLEANING

- A On completion of installation, inspect interior and exterior of switchgear. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

V30.3.10 DEMONSTRATION

- A Engage a factory-authorized service representative to train Employer's maintenance personnel to adjust, operate, and maintain all field located LV distribution equipment.

V31 LOW VOLTAGE SWITCHGEAR

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V31.1 PART 1 – GENERAL

V31.1.1 RELATED DOCUMENTS

- A Drawings and general provisions of the Contract, including main Contract Preliminaries and section A of this specification.
- B For performance details and physical sizes of plant and equipment refer to section D “Schedules of Equipment”.
- C For system descriptions, operating parameters and ambient temperatures refer to section B of this specification and the Schedules of Equipment.
- D Refer also to the following sections:
 - 1 V21: Low Voltage Switchgear
 - 2 V30: Low Voltage Distribution Systems
 - 3 V80: Electrical Identification
 - 4 V81: Earthing and Bonding Systems
 - 5 Y50: Testing and Commissioning of mechanical and Electrical Services
 - 6 Y60: Conduit and trunking
 - 7 Y61: LV & ELV Cables
 - 8 Y63: Cable Supports
 - 9 Y90: Fixing to Building.

V31.1.2 SUMMARY

- A This Section includes:
 - 1 Main LV Switchgear
 - 2 LV Sub-main boards
 - 3 Final Circuit Boards
 - 4 Battery and charger unit
 - 5 Automatic Transfer switches
 - 6 Air Circuit Breakers
 - 7 Protection devices Interposing and inter-tripping relays
 - 8 Voltage sensing relays
 - 9 Trip/close switches and control selector switches
 - 10 Current transformers
 - 11 Instruments and meters
 - 12 Indicator lights
 - 13 Power Factor Correction
 - 14 Harmonic Filtration
 - 15 Surge Protection
 - 16 SCADA systems
 - 17 Switchgear and controlgear accessories.

V31.1.3 DEFINITIONS

- A The following definitions are used in this specification:
 - 1 A.C: Alternating Current
 - 2 D.C: Direct Current
 - 3 HV: High Voltage: Voltage $\geq 35\text{kV}$ but for this document also includes MV
 - 4 MV: Medium Voltage: Voltage $\geq 1.0\text{kV}$ and $\leq 35\text{kV}$ referred to as HV in this document
 - 5 LV: Low Voltage: Voltage
 - a A.C: $\geq 50\text{V}$ and $\leq 1000\text{V}$ or 600V between conductors and earth
 - b D.C: 1500V between conductors or 900V between conductors and Earth
 - 6 ELV: Extra Low Voltage:
 - a A.C: $<50\text{V}$

- b D.C. <120V ripple-free
- 7 XLPE: Crosslinked Polyethylene
- 8 LSF: Low Smoke and Fume.
- 9 ATS: Automatic Transfer Switches
- 10 SCADA: Supervisory Control and Data Acquisition.
- 11 MCC – Motor Control Centre
- 12 rh: relative humidity
- 13 ACB: Air Circuit Breaker
- 14 DNO: District Network Operator
- 15 PES: Public Electricity Supply
- 16 PWN: Private Wire Network
- 17 ASTA: Association of short-circuit Authorities, an international bench marking authority
- 18 KEMA: Testing laboratory.

- B Pollution Degree: As defined in IEC 60947-1. It is a conventional number based on the amount of conductive or hygroscopic dust, ionized gas or salt, and on the relative humidity and its frequency of occurrence resulting in hygroscopic absorption or condensation of moisture leading to reduction in dielectric strength and/or surface resistivity the environmental conditions for which the assembly is intended. For switching components inside an enclosure, the pollution degree are as follows:
- 1 Pollution degree 1: No pollution or only dry, non-conductive pollution occurs. The pollution has no influence
 - 2 Pollution degree 2: Only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation is to be expected
 - 3 Pollution degree 3: Conductive pollution occurs, or dry, non-conductive pollution occurs which is expected to become conductive due to condensation
 - 4 Pollution degree 4: Continuous conductivity occurs due to conductive dust, rain or other wet conditions.

V31.1.4 PERFORMANCE REQUIREMENTS

- A To supply and install all main LV Switchgear/switchboards as indicated on the drawings and as required for safe maintenance of all equipment. It includes low voltage circuit breakers, switches, isolators, HRC fuses, miniature circuit breakers and moulded case circuit breakers i.e. all the accessories required to protect the LV system.
- B The basic function of LV switchgear is to provide:
- 1 Electrical Protection for:
 - a Circuits: to protect against the thermal and mechanical stresses of short-circuit currents
 - b Personnel: protection against insulation failure
 - c Electric motors/appliances served: against overheating, overload.
 - 2 Isolation control:
 - a To de-energise the circuits to enable safe working on circuits or equipment
 - 3 Switchgear control:
 - a Functional control: routine switching control for normal operation
 - b Emergency switching: emergency stop
 - c Maintenance: isolation facilities for safe working on equipment or circuits.
- C All switch disconnect devices shall be suitable for their application, rated for the fault level at the point in the installation at which they are connected and to break the appropriate load of the equipment (load break), unless otherwise stated.
- D Service Conditions: The following conditions apply for installations below 2000m. For higher altitudes take into account the reduction in dielectric strength, the switching capability of the devices and the cooling effect of the air.
- 1 Indoor installations:
 - a Maximum air temperature/relative humidity: +40°C/50% rh

- b Average over 24h: $\leq +35^{\circ}\text{C}$
- c Minimum temperature: -5°C
- d Humidity varies with temperature (max 90% at $+20^{\circ}\text{C}$)
- e Pollution degree:
 - Commercial applications: Degree 2
 - Industrial applications: Degree 3.
- 2 Outdoor installations:
 - a Maximum air temperature: $+40^{\circ}\text{C}$
 - b Average over 24h: $\leq +35^{\circ}\text{C}$
 - c Minimum temperature: -25°C
 - d Humidity: 100% at $+25^{\circ}\text{C}$ (varies with temperature)
 - e Pollution degree:
 - External applications: Degree 4.
- 3 For special service conditions: refer to equipment schedules and section B of this specification. Special service conditions may include:
 - a Vibration
 - b Exceptional condensation
 - c Very heavy pollution
 - d Corrosive environment
 - e Strong magnetic fields
 - f Fungus
 - g Small creatures
 - h explosion hazards
 - i earthquakes
 - j Unless otherwise stated, assemblies for industrial applications are generally for use in a pollution degree 3 environment. However, other pollution degrees may be considered to apply, depending upon particular applications or the micro-environment.

E Provide for the following where indicated in this specification, schedules or drawings:

- 1 Energy and performance monitoring
- 2 Automatic changeover on mains failure
- 3 Power factor correction
- 4 Harmonic filtering
- 5 Surge Protection.

V31.1.5 ENERGY AND PERFORMANCE MONITORING REQUIREMENTS

A For incoming Utility company metering: Comply with DNO/PWO requirements:

- 1 LV supply refer to section V11.
- 2 High voltage supply refer to section V10.

B For end user metering comply with the requirements of the building regulations. Provide logging LCD display logging multi-meters on each incoming section of Main LV Switchboards and as shown on the drawings, to provide:

- 1 Volts and current per phase
- 2 KW
- 3 KVA
- 4 KVAR
- 5 Power factor
- 6 Maximum Demand
- 7 KWhr
- 8 Frequency
- 9 Total Harmonic Distortion (current and voltage).

- C Where shown on schematics logging sub-meters shall be provided to monitor certain outgoing circuits and incorporate the data onto the power-monitoring network. They shall provide:
- 1 Volts and current per phase
 - 2 KW
 - 3 KVA
 - 4 KVAR
 - 5 Power factor
 - 6 Maximum Demand
 - 7 KWhr
 - 8 Frequency
 - 9 Total Harmonic Distortion (current and voltage).
- D Readings:
- 1 To be selected via keypads on the front of the multi-meters.
 - 2 Provide true RMS readings irrespective of waveform, to class 1.0 accuracy.
- E Logging: Log all alarm events. The following parameters shall be recorded via the multi-meters:
- 1 At alarm pick-up
 - 2 Event type
 - 3 Date
 - 4 Time
 - 5 Most extreme reading during pick-up delay
 - 6 During alarm drop out
 - 7 Date
 - 8 Time
 - 9 Most extreme reading during alarm event.
- F Provide the multi-meters with the following facilities:
- 1 Sufficient on-board memory to store a minimum of 8 days reading
 - 2 Memory capable of being extended to 40 days
 - 3 Facility to capture waveforms by sampling all current and voltage simultaneously, at a minimum rate of 64 times per cycle waveform
 - 4 Storage of waveform for later retrieval
 - 5 Waveform capture triggered either internally by a defined alarm condition or externally.
- G Data Recording: Ensure that the multi-meters and sub-meters are capable of transmitting readings to
- 1 BMS system
 - 2 SCADA data network to a central PC (if indicated in section B of this specification).

V31.1.6 MAINS FAILURE /GENERATOR AUTOMATIC CHANGEOVER OPERATIONAL REQUIREMENTS

- A Where required and as indicated in section B of this specification provide a power generation system to serve the essential loads indicated on the drawings. For generator specification refer to section V12 of this specification.
- B The mains/generator changeover operation shall be achieved at the LV switchboards which have essential and non-essential supplies or by using Automatic Transfer Switches (ATS) as indicated on the drawings. Where the switchboard has an essential supply section it shall be located in a separate free-standing floor mounted enclosure linked by a bus bar.
- C A main feeder failure shall be sensed at the LV switchgear panel or by any one of the ATS units containing an essential supply and signal the generator/s to start.
- D The generator start up and synchronising procedure is achieved by the generator control panel and is described in section V12 of this specification.

- E The generator supply circuit breaker shall be mechanically and electrically interlocked to prevent the paralleling of mains and generator supplies.
- F The following shall happen when a mains failure occurs at the non-essential section of the LV switchboards:
- 1 The loss of mains supplies from the transformer shall cause the main incoming breaker to the non-essential section to trip via a shunt trip
 - 2 The mains failure to the non-essential section shall be detected by a phase failure relay on the non-essential section busbars of the LV switchboard
 - 3 The bus section switch associated with the essential supplies section shall trip
 - 4 At the same time a signal is sent to the generator to start
 - 5 When the generator voltage is present at the incoming generator circuit breaker on the essential section of the switchboard, the LV switchboard senses this condition and closes the incoming generator circuit breaker
 - 6 If mains failure to the non-essential section was caused by a loss of incoming mains from the transformer, the main incoming breaker to the non-essential section shall automatically reclose when main supplies become available again, providing the local/remote selector switch is in the remote position and the bus-coupler is in the open position
 - 7 The generator supplies shall remain connected to the essential section until a manual signal is given to change back to mains supplies. The above process will then be reversed with restoring mains to the essential section of the switchboard
 - 8 The 'start' signal to the generator shall then be removed
 - 9 Only the following conditions causing loss of supply to the LV switchboard shall inhibit the automatic starting of the generator sequence
 - 10 Short circuit trip of the incoming main ACB
 - 11 Earth fault trip of the incoming main ACB and subsequent failure of bus-coupler to open
 - 12 Under these conditions a volt free contact shall be provided to signal to the BMS system 'LV Panel XX Generator start inhibited'.
- G The essential services bus-section and the generator supply incoming circuit breaker shall be mechanically and electrically interlocked to prevent the paralleling of mains and generator supplies.

V31.1.7 SUBMITTALS

- A Refer to Section A of this specification.
- B Product Data: For each type of switchgear, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- C Shop Drawings: For each type of switchgear and related equipment:
- D Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:
- 1 Tabulation of installed devices with features and ratings
 - 2 Enclosure types and details
 - 3 Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section
 - 4 Bus configuration with size and number of conductors in each bus run, including phase, neutral, and ground conductors of main and branch buses
 - 5 Current rating of buses
 - 6 Short-time and short-circuit current rating of switchgear assembly
 - 7 Nameplate legends
 - 8 Mimic-bus diagram
 - 9 Metering provisions with indication of approval by utility company if required
 - 10 CE listing /approvals for performance of installed devices

- 11 Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components
- 12 Wiring Diagrams:
 - a Power, signal, and control wiring
 - b Schematic diagrams showing connections to remote devices including SCADA remote terminal unit.
- E Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around switchgear where piping and ducts are prohibited. Show component layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Identify field measurements.
- F Samples: Representative portion of mimic bus diagram with specified finish. Manufacturer's colour charts showing colours available for mimic bus.
- G Qualification Data: For testing agency.
- H Field quality-control test reports.
- I Operation and Maintenance Data: For switchgear and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section A "Operation and Maintenance Data," include the following:
 - 1 Manufacturer's written instructions for testing and adjusting overcurrent protective devices
 - 2 Time-current curves, including selectable ranges for each type of overcurrent protective device.

V31.1.8 QUALITY ASSURANCE

- A Ensure that the design, construction, material and finishes of all component parts will be suitable for the local climatic and service operating conditions and as indicated in this specification and drawings.
- B Ensure that the whole installation complies with the latest editions of the relevant standards, including the following:
 - 1 BS 89-2: Direct acting indicating analogue electrical measuring instruments and their accessories. Specification for special requirements for ammeters and voltmeters
 - 2 BS 89-3: Direct acting indicating analogue electrical measuring instruments and their accessories. Specification for special requirements for wattmeters and varmeters
 - 3 BS 3693: Recommendations for design of scales and indexes on analogue indicating instruments
 - 4 BS 8431: Electrical static meters for secondary metering and sub-metering. Specification
 - 5 BS 6290-2 - Lead-acid stationary cells and batteries. Specification for the high-performance Plante positive type
 - 6 BS 6290-3 - Lead-acid stationary cells and batteries. Specification for the flat positive plate type
 - 7 BS 7430 - Code of practice for protective earthing of electrical installations
 - 8 BS 7671+A3 - Requirements for electrical installations. IET Wiring Regulations. Seventeenth edition
 - 9 BS EN 1011-2: Welding. Recommendations for welding of metallic materials. Arc welding of ferritic steels
 - 10 BS EN 10210-2: Hot finished structural hollow sections of non-alloy and fine grain steels. Tolerances, dimensions and sectional properties
 - 11 BS EN 50272-1: Safety requirements for secondary batteries and battery installations. General safety information
 - 12 BS EN 60051-1: Direct acting indicating analogue electrical measuring instruments and their accessories. Definitions and general requirements common to all parts
 - 13 BS EN 60073: Basic and safety principles for man-machine interface, marking and identification. Coding principles for indicators and actuators
 - 14 BS EN 60086-1 - Primary batteries. General
 - 15 BS EN 60086-2 - Primary batteries. Physical and electrical specifications
 - 16 BS EN 60112+A1: Method for the determination of the proof and the comparative tracking indices of solid insulating materials
 - 17 BS EN 60255-1: Measuring relays and protection equipment. Common requirements

- 18 BS EN 60269-1: +A2, BS 88-1: +A2: Low-voltage fuses. General requirements
- 19 BS HD 60269-2, BS 88-2: Low-voltage fuses. Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application). Examples of standardized systems of fuses A to K
- 20 BS EN 60529 + A2: Degrees of protection provided by enclosures (IP code)
- 21 BS EN 60898-1: +A13: Electrical accessories. Circuit breakers for overcurrent protection for household and similar installations. Circuit-breakers for a.c. operation
- 22 BS EN 60898-2: Electrical accessories. Circuit-breakers for overcurrent protection for household and similar installations. Circuit-breakers for a.c and d.c. operation
- 23 BS EN 60947-1+A2: Low-voltage switchgear and controlgear. General rules
- 24 BS EN 60947-2+A2: Low-voltage switchgear and controlgear. Circuit-breakers
- 25 BS EN 60947-3+A2: Low-voltage switchgear and controlgear. Switches, disconnectors, switch-disconnectors and fuse-combination units
- 26 BS EN 60947-4-3: Low-voltage switchgear and controlgear. Contactors and motor-starters. AC semiconductor controllers and contactors for non-motor loads
- 27 BS EN 60947-5-5: +A11: IEC 60947-5-5: Low-voltage switchgear and controlgear. Control circuit devices and switching elements. Electrical emergency stop device with mechanical latching function
- 28 BS EN 60947-6-1: +A1: Low-voltage switchgear and controlgear. Multiple function equipment. Transfer switching equipment
- 29 BS EN 60947-7-1: Low-voltage switchgear and controlgear. Ancillary equipment. Terminal blocks for copper conductors
- 30 BS EN 60947-7-2: Low-voltage switchgear and controlgear. Ancillary equipment. Protective conductor terminal blocks for copper conductors
- 31 BS EN 60947-7-3: Low-voltage switchgear and controlgear. Ancillary equipment. Safety requirements for fuse terminal blocks
- 32 BS EN 60947-7-4: Low-voltage switchgear and controlgear. Ancillary equipment. PCB terminal blocks for copper conductors
- 33 BS EN 60947-8: +A2: Low-voltage switchgear and controlgear. Control units for built-in thermal protection (PTC) for rotating electrical machines
- 34 BS EN 61000-6-1: Electromagnetic compatibility (EMC). Generic standards. Immunity for residential, commercial and light-industrial environments
- 35 BS EN 61000-6-2 - Electromagnetic compatibility (EMC). Generic standards.
- 36 BS EN 61000-6-3+A1 - Electromagnetic compatibility (EMC). Generic standards. Emission standard for residential, commercial and light-industrial environments
- 37 BS EN 61000-6-4+A1 - Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments
- 38 BS EN 61008-1: +A11: Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs). General rules
- 39 BS EN 61008-2-1: Specification for residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs). Applicability of the general rules to RCCBs functionally independent of line voltage
- 40 BS EN 61056-1: General purpose lead-acid batteries (valve-regulated types). General requirements, functional characteristics. Methods of test
- 41 BS EN 61056-2: General purpose lead-acid batteries (valve-regulated types). Dimensions, terminals and marking
- 42 BS EN 61111: Live working. Electrical insulating matting
- 43 BS EN 61439-1: Low-voltage switchgear and controlgear assemblies. General rules
- 44 BS EN 61439-2: Low-voltage switchgear and controlgear assemblies. Power switchgear and controlgear assemblies
- 45 BS EN 61439-3: Low-voltage switchgear and controlgear assemblies. Distribution boards intended to be operated by ordinary persons (DBO)
- 46 BS EN 61439-5: Low-voltage switchgear and controlgear assemblies. Assemblies for power distribution in public networks
- 47 BS EN 61439-6 Low-voltage switchgear and controlgear assemblies. Busbar trunking systems (busways)

- 48 BS EN 61643-11: Low-voltage surge protective devices. Surge protective devices connected to low-voltage power systems. Requirements and test methods
- 49 BS EN 61869-2: Instrument transformers. Additional requirements for current transformers
- 50 BS EN 62053-11: Electricity metering equipment (A.C.). Particular requirements. Electromechanical meters for active energy (classes 0,5, 1 and 2)
- 51 BS EN ISO 1461: Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods
- 52 ENA G5/4-1: Engineering Recommendation "Planning Levels for Harmonic Voltage Distortion and Connection of Non-Linear Equipment to Transmission Systems and Distribution Networks in the UK.

- C Source Limitations: Obtain each component through one source from a single manufacturer wherever possible. Select from the manufacturers indicated in this specification.
- D Electrical Components, Devices, and Accessories: Shall be listed and labelled as defined in the IET Wiring regulations, CE certified and marked for intended use.

V31.1.9 DELIVERY, STORAGE, AND HANDLING

- A Check access route for all factory assembled components. Deliver in sections lengths that can be moved into place past any obstructions.
- B Store components indoors in clean dry space with uniform temperature to prevent condensation. Protect components from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- C Interruption of Existing Electrical Service: Do not interrupt electrical service to existing facilities unless permitted by the CA after arranging to provide temporary electrical service according to requirements indicated.

V31.1.10 COORDINATION

- A Coordinate layout and installation of components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.
- B Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements.

V31.2 PART 2 - PRODUCTS

V31.2.1 LV ASSEMBLIES GENERAL

- A Construct LV assemblies of materials capable of withstanding the mechanical, electrical, thermal and environmental stresses that are likely to be encountered in specified service conditions.
- B Provide protection against corrosion.
- C For external assemblies provide protection against ingress of water and from ultra-violet radiation.
- D Provide facilities for safely lifting assemblies to enable them to be manoeuvred into place.
- E Construct main LV switchgear so that additional sections can be added in the future if so required.

V31.2.2 MANUFACTURERS

- A Available Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - 1 ABB
 - 2 Siemens Energy & Automation
 - 3 Square D; Schneider Electric
- B All main LV switchgear, LV switchboards, sub main distribution boards and final circuit distribution boards shall be of the same manufacture unless indicated otherwise.

V31.2.3 MAIN LV SWITCHGEAR/SWITCHBOARDS

- A Provide main LV switchgear/main LV switchboards as indicated on the drawings and equipment schedules.
- B Construction: LV switchgear comprises one or more vertical cubicle sections joined together to form a free-standing rigid, floor mounted assembly capable of extension. Construct as follows and/or as indicated on the schedules of equipment:
 - 1 Construction:
 - a Standard: BS EN 61439-1
 - b Frame: Steel minimum 2.0mm
 - c Cladding: Steel minimum 1.5mm
 - d Finish:
 - Indoor: Zinc or Alu-zinc coated, and powder coated to manufacturer's standard or colour as scheduled
 - Outdoor: Galvanised steel
 - 2 Forms of Internal separation:
 - d Main LV Switchboards: Form 4b Type 6 or as scheduled
 - e Standard: BS EN 61439-2 and Type Tested
 - 3 Cable Connections: Top or bottom entry as scheduled or where not indicated provide for the following:
 - f Main Boards: top entry and top exit
 - g Sub-main: bottom entry and top exit
 - 4 Access to terminations: As scheduled or where not indicated provide:
 - h Main Boards: from the rear only
 - i Sub-main: from front only.
 - 5 Enclosures protection rating: According to standard BS EN 60529
 - a Within plantrooms: IP54
 - j Other internal locations: IP41
 - k Outdoor: IP66.
 - 6 Mounting: Floor mounted, rear or front access, as indicated on the schedules and drawings.
 - 7 Testing: 3rd party accredited company,
 - 8 Certification: CE certified, ASTA, KEMA
 - 9 Fault level: refer to specification section B and schedules of equipment.
 - 10 Rated operational voltage: 400V +10%,-6%,

- 11 Tolerances: as Utility requirements or local regulations.
- 12 Neutrals: Full size

C Protective Devices: Provide protective devices of the following types on the incoming and outgoing ways:

- 1 Incoming:
 - a Withdrawable air circuit breakers, complete with overcurrent and earth fault protection
 - b Standard: BS EN 60947-2+A2
- 2 Outgoing: All MCCBs and Fused switches to be of the "plug-in" type
 - l For circuits upto 800A
 - Fused switches
 - Standards: BS EN 60947-1,3,5 & BS EN 60269-1 to 4
 - a For circuits 800A to 1250A
 - 3 Pole moulded case circuit breakers (MCCB)
 - Standard: BS EN 60947-2+A2
 - b For circuits above 1250A
 - air circuit breakers
 - Standard: BS EN 60947-2+A2.
 - c Surge Protection: Integral surge protection devices as specified in the Power filter section of this specification on each main switchboard incomer.

D Where MCCBs are provided construction to be:

- 1 Outgoing MCCB: plug in type mounted on fully withdrawable trays
- 2 Trays: prewired with auxiliary contacts for metering and monitoring of supplies and also for future replacement of standard MCCB's with motorised MCCB's should the client wish to provide further automatic control as and when necessary
- 3 All MCCB withdrawable trays shall be provided with these facilities
- 4 Provide a blank plate in the face of each MCCB tray to enable the future provision of a kw hour meter should the client require this in the future.

E Provide **selected** MCCB's with motorised breakers and interfaced with the SCADA control system to allow for automatic load shedding should this be necessary, motorised MCCB's or MCCB's with shunt trips are identified on the schematic drawings.

F Load break switches: Used as main isolators for switch boards and between separate busbar (bus section isolators) shall comply with BS EN 60947-3+A1 in particular as well as other relevant standards quoted in this specification.

G Switches: Select to exhibit excellent trade resistance of isolator material in switch frame (CTV > 600C, BS EN 60112+A1) to prevent flashover between phases.

H For essential and non-essential boards: provide mechanical and electrical interlocks between the bus section switches on the LV switchboards (between the non-essential section and the essential section) and the relevant ACB on the incoming generator to prevent the paralleling of the generator supplies with the mains.

I Terminals: Provide tinned copper terminals complete with terminal shields for external conductor, control and auxiliary circuits.

J Busbars: Comply with the following throughout the switchboards:

- 1 Type: copper
- 2 Rating:
 - a 1600A: for switchboards served by a 1MVA transformer
 - b 1200A: for switchboards served by a 0.8MVA transformer
 - c 800A: for switchboards served by a 0.5MVA transformer.

K The following operations shall be performed when assembly is in service and under voltage:

- 3 Visual inspection of switching devices and other apparatus
 - 4 Settings and indicators of relays and releases
 - 5 Conductor connections and markings
 - 6 Adjusting and re setting of relays, releases and electronic devices
 - 7 Replacement of fuselinks and indicating lamps
 - 8 Fault location by voltage and current measuring.
- L The following shall be provided for maintenance of the assembly:
- 1 Provide space between functional unit or group and adjacent functional units or groups
 - 2 Provide removable fastening devices such as locks, screws, etc. for parts likely to be removed for maintenance.
- M Provision for Future Devices: Equip compartments with rails, mounting brackets, supports, necessary appurtenances, and bus connections.
- N Controls:
- a Control Power Supply: DC battery system
 - b Control Wiring: Factory installed, complete with bundling, lacing, and protection
 - c Conductors sized according to manufacturer's requirements for duty required.
- O Logging Multi-meter: Microprocessor-based unit suitable for three- or four-wire systems for each main LV switchgear/LV switchboards. Provide the following features:
- 1 Inputs from sensors or 5-A current-transformer secondary's, and potential terminals rated to 600V.
 - 2 Switch-selectable digital display with the following features:
 - a Phase Currents, Each Phase: $\pm 1\%$
 - b Phase-to-Phase Voltages, Three Phase: $\pm 1\%$
 - c Phase-to-Neutral Voltages, Three Phase: $\pm 1\%$
 - d Three-Phase Real Power: $\pm 2\%$
 - e Three-Phase Reactive Power: $\pm 2\%$
 - f Power Factor: $\pm 2\%$
 - g Frequency: $\pm 0.5\%$
 - h Integrated Demand, with Demand Interval Selectable from 5 to 60 Minutes: $\pm 2\%$
 - i Accumulated energy.
 - In kilowatt hours, $\pm 2\%$;
 - Stored values unaffected by power outages for up to 72 hours.
- P Provide Communications module suitable for remote monitoring of meter quantities and functions. Interface communication and metering requirements according to V11 "Low Voltage Connections".
- Q Display and Control Units Mounting: flush or semi-flush mounted in instrument compartment door.
- R Mimic Bus: Provide a continuous mimic bus, arranged in single-line diagram format, using symbols and lettered designations consistent with approved mimic-bus diagram:
- 1 Mimic-bus segments coordinated with devices in switchgear sections to which applied, to produce a concise visual presentation of principal switchgear components and connections
 - 2 Medium: Painted graphics, (seek approval from CA to colours and style)
 - 3 Colour: Contrasting with factory-finish background and approved by CA.
- S System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads. Include as-built data for low-voltage power switchgear and connections as follows:
- 1 Frame size of each circuit breaker
 - 2 Trip rating for each circuit breaker
 - 3 Conduit and wire size for each feeder.

V31.2.4 LV SUB-MAIN SWITCHBOARDS

- A LV sub-main switchboards, comprising one or more vertical cubicle sections joined together to form a free-standing rigid, floor mounted assembly capable of extension. Construct as follows and/or as indicated on the schedules of equipment:
- 1 Construction:
 - a Standard: BS EN 61439-1
 - b Frame: Steel minimum 2.0mm
 - c Cladding: Steel minimum 1.5mm
 - d Finish:
 - Indoor: Zinc or Alu-zinc coated, and powder coated to manufacturer's standard or colour as scheduled
 - Outdoor: Galvanised steel.
 - 2 Forms of Internal separation:
 - a Sub-Main Switchboards: Form 3bType 2 or as scheduled
 - b Standard: BS EN 61439-2 and Type Tested
 - 3 Cable Connections: Top or bottom entry as scheduled or where not indicated provide for the following:
 - a Main Boards: top entry and top exit
 - b Sub-main: bottom entry and top exit
 - 4 Access to terminations: As scheduled or where not indicated provide:
 - a Main Boards: from the rear only
 - b Sub-main: from front only.
 - 5 Enclosures
 - a Within plantrooms: IP54
 - b Other internal locations: IP41
 - c Outdoor: IP66.
 - 6 Mounting: Floor mounted, rear or front access, as indicated on the schedules and drawings
 - 7 Testing: 3rd party accredited company
 - 8 Certification: only KEMA or ASTA
 - 9 Fault level: refer to specification section B and schedules of equipment
 - 10 Rated operational voltage: 400V +10%-6%
 - 11 Tolerances: as Utility requirements or local regulations
 - 12 Neutrals: Full size.
- B Protective Devices: Provide protective devices of the following types on the incoming and outgoing ways:
- 1 Incoming:
 - a Withdrawable air circuit breakers, complete with Overcurrent and Earth fault protection
 - b Standard: BS EN 60947-2+A2
 - 2 Outgoing: All MCCBs and Fused switches to be of the "plug –in" type
 - a For circuits upto 800A
 - Fused switches
 - Standards: BS EN 60947-1,3,5 & BS EN 60269-1 to 4
 - b For circuits 800A to 1250A
 - 3 Pole moulded case circuit breakers (MCCB)
 - Standard: BS EN 60947-2+A2
 - c For circuits above1250A
 - air circuit breakers
 - Standard: BS EN 60947-2+A2.
 - 3 Surge Protection: Integral surge protection devices as specified in the Power filter section of this specification on each main switchboard incomer.
- C Where MCCBs are provided construction to be:
- 1 Outgoing MCCB: plug in type mounted on fully withdrawable trays

- 2 Trays: prewired with auxiliary contacts for metering and monitoring of supplies and also for future replacement of standard MCCB's with motorised MCCB's should the client wish to provide further automatic control as and when necessary
 - 3 All MCCB withdrawable trays shall be provided with these facilities
 - 4 Provide a blank plate shall be provided in the facia of each MCCB tray to enable the future provision of a kw hour meter should the client require this in the future.
- D Provide selected MCCB's with motorised breakers and interfaced with the SCADA control system to allow for automatic load shedding should this be necessary, motorised MCCB's or MCCB's with shunt trips are identified on the schematic drawings.
- E Load break switches: Used as main isolators for switch boards and between separate busbar (bus section isolators) shall comply with BS EN 60947-3+A1 in particular as well as other relevant standards quoted in this specification.
- F Switches: Select to exhibit excellent trade resistance of isolator material in switch frame (CTV> 600C, BS EN 60112+A1) to prevent flashover between phases.
- G For essential and non-essential boards: provide mechanical and electrical interlocks between the bus section switches on the LV switchboards (between the non-essential section and the essential section) and the relevant ACB on the incoming generator to prevent the paralleling of the generator supplies with the mains.
- H Terminals: Provide tinned copper terminals complete with terminal shields for external conductor, control and auxiliary circuits.
- I Busbars: Comply with the following throughout the switchboards:
- 1 Type: copper
 - 2 Rating:
 - a Sub-main distribution boards: maximum 800A busbar rating.
- J The following operations shall be performed when assembly is in service and under voltage:
- 1 Visual inspection of switching devices and other apparatus
 - 2 Settings and indicators of relays and releases
 - 3 Conductor connections and markings
 - 4 Adjusting and re setting of relays, releases and electronic devices
 - 5 Replacement of fuselinks and indicating lamps
 - 6 Fault location by voltage and current measuring.
- K The following shall be provided for maintenance of the assembly:
- 1 Provide space between functional unit or group and adjacent functional units or groups
 - 2 Provide removable fastening devices such as locks, screws, etc. for parts likely to be removed for maintenance.
- L Provide metering on outgoing circuits where indicated in the schematic drawings.

V31.2.5 FINAL CIRCUIT DISTRIBUTION BOARDS TYPE A- SINGLE PHASE

- A Distribution boards containing switching or protection devices for each outgoing circuit arranged in a wall mounted or flush mounted cabinet enabling distribution of single-phase supplies. Construct as follows and/or as indicated on the schedules of equipment:
- B Types: To BS EN 61439-3: Provide meters as required by metering strategy indicated in section B.
- 1 A1: Application Single phase standard distribution boards with single pole or double pole ways as indicated on the schedules
 - 2 A2: Application Multi service single phase distribution boards
 - 3 A3: Application Single phase Split load distribution boards.

C Casing Construction:

- 1 Enclosure: 0.6mm min Sheet steel enclosure
- 2 Access door: Hinged and lockable front access door
- 3 Mounting: wall or flush as indicated on drawings
- 4 Protection:
 - a within plantrooms & risers: IP54
 - b Other Internal locations: IP31
 - c External locations: IP65
 - d Standard: IEC 61439-3.
- 5 Locks must be supplied with the same key for every board
- 6 Suitably rated integral isolator/switch disconnecter
- 7 Finish: Zinc or Alu-zinc coated, and powder coated to manufacturer's standard or colour as scheduled.

D The number of ways indicated on the drawings/distribution schedules each provided with an "x" type MCB in accordance with BS EN 60898 to 15kA. Allow for 20% spare capacity.

E All miniature circuit breakers shall be capable of accepting a full range of electrical accessories to allow their adaptation where specified or at a later date to have earth leakage protection, remote tripping facilities or electrical contacts which will signal the position of the main contacts and/or MCB mechanism (whether tripped or not).

F All miniature circuit breakers shall be capable of accepting a complete range of mechanical accessories, as a minimum this range shall include terminal shields, padlocking facility and an identification system.

G Each distribution board shall have a chart stating the location of all points controlled by each way with the rating of the fuse or MCB for that way. The charts shall be typewritten, pasted on stiff board and framed Perspex fixed to the inside of the distribution board door.

H Residual Current Devices (RCD's) shall be manufactured to BS EN 61008 and installed to meet the requirements of BS 7671 with a sensitivity of 30mA. RCD's shall be either single self-contained units enclosed in moulded casings of high dielectric strength or comprise a number of individual.

I Provide combined 30mA MCB/RCD units for all outgoing ways feeding general power BS 1363 socket outlets within all areas.

J Provide combined 30mA MCB/RCD units for outgoing ways feeding lighting circuits only where specifically indicated on the drawings.

K Internal Construction:

- 1 Fully type tested conditional short circuit rating of 16kA to BS EN 61439-3
- 2 High performance MCB
 - a 10kA BS EN 60898
 - b 15kA BS EN 60947-2 in B, C or D curve single and double pole.
- 3 Busbar:
 - a Fully encapsulated
 - b 125A busbar rating as scheduled to suit the connected loads
 - c Isobar disconnection to BS EN 60947-3 ensuring unused outgoing ways are isolated
 - d Fully rated neutral bar.
- 4 Suitably sized dual earth terminal bar
- 5 Option of switching outgoing neutral on all boards using distributed neutral kit
- 6 Terminal block for feeding up to 100A
- 7 Range of incomers:
 - a Switch disconnectors
 - b Residual current devices
 - c Terminal blocks.
- 8 Single pole RCBO for new or retrofit maintaining device density
- 9 Full range of device accessories and auxiliaries

- 10 Knockouts for cable gland and conduit mixed to suit the installation needs without loss of space
- 11 Fully shrouded connections when main switch is fitted
- 12 Wide range of add-on auxiliaries:
 - a Shunt trips,
 - b Auxiliary switches
 - c Add-on earth leakage modules.
- 13 Non removable interlock to prevent operation unless an outgoing device is fitted
- 14 Metering: Provide standard option kWh meters for all boards that have an input power $\geq 20\text{kW}$ to allow the data to be picked up by the BMS/Energy monitoring system. Refer also to the distribution board schedule for other metering options which could be required:
 - a Standard,
 - b Meter ready
 - c Split metered
 - d Multiservice options.

V31.2.6 FINAL CIRCUIT DISTRIBUTION BOARDS TYPE B- THREE PHASE

- A Distribution boards containing switching or protection devices for each outgoing circuit arranged in a wall mounted or flush mounted cabinet enabling distribution of three phase supplies. Construct as follows and/or as indicated on the schedules of equipment:
- B Types: To BS EN 61439-3: Note that boards with integral meters are required to be provided as indicated in section B metering strategy.
 - 1 B1: Application - Three phase standard distribution boards with single pole or double pole ways as indicated on the schedules
 - 2 B2: Application – Three phase distribution boards supplied with integral 3 ph kWh meters
 - 3 A3: Application Single phase Split load distribution boards.
- C Casing Construction:
 - 1 Enclosure: 1.0mm min Sheet steel enclosure
 - 2 Access door: Hinged and lockable front access door
 - 3 Mounting: wall or flush as indicated on drawings
 - 4 Protection:
 - a within plantrooms & risers: IP54
 - b Other Internal locations: IP31.
 - c External locations: IP65
 - d Standard: IEC 61439-3.
 - 5 Locks must be supplied with the same key for every board
 - 6 Suitably rated integral isolator/switch disconnecter
 - 7 Finish: Zinc or Alu-zinc coated, and powder coated to manufacturer's standard or colour as scheduled.
- D The number of ways indicated on the drawings/distribution schedules each provided with an "x" type MCB in accordance with IEC 60898 to 15kA. Allow for 20% spare capacity.
- E All miniature circuit breakers shall be capable of accepting a full range of electrical accessories to allow their adaptation where specified or at a later date to have earth leakage protection, remote tripping facilities or electrical contacts which will signal the position of the main contacts and/or MCB mechanism (whether tripped or not).
- F All miniature circuit breakers shall be capable of accepting a complete range of mechanical accessories, as a minimum this range shall include terminal shields, padlocking facility and an identification system.
- G Each distribution board shall have a chart stating the location of all points controlled by each way with the rating of the fuse or MCB for that way. The charts shall be typewritten, pasted on stiff board and framed Perspex fixed to the inside of the distribution board door.

- H Residual Current Devices (RCD's) shall be manufactured to BS EN 61008 and installed to meet the requirements of BS 7671 with a sensitivity of 30mA. RCD's shall be either single self-contained units enclosed in moulded casings of high dielectric strength or comprise a number of individuals.
- I Provide combined 30mA MCB/RCD units for all outgoing ways feeding general power BS 1363 socket outlets within all areas:
- J Provide combined 30mA MCB/RCD units for outgoing ways feeding lighting circuits only where specifically indicated on the drawings.
- K Internal Construction:
 - 1 Fully type tested conditional short circuit rating of 25kA to BS EN 61439-3
 - 2 High performance MCB
 - a 10kA BS EN 60898
 - b 15kA BS EN 60947-2 in B, C or D curve 1, 2, 3, 4 pole
 - 3 Busbar:
 - a 250A busbar rating
 - b Isobar disconnection to BS EN 60947-3 ensuring unused outgoing ways are isolated
 - 4 Option of switching outgoing neutral on all boards using distributed neutral kit
 - 5 Terminal block for feeding up to 200A
 - 6 Range of incomers:
 - a switch disconnectors,
 - b residual current devices,
 - c terminal blocks, MCCB
 - 7 Single pole RCBO for new or retrofit maintaining device density
 - 8 Full range of device accessories and auxiliaries
 - 9 Knockouts for cable gland and conduit mixed to suit the installation needs without loss of space
 - 10 Removable insulated pan assembly
 - 11 Fully shrouded neutral
 - 12 Split neutral bars
 - 13 Removable gland plates
 - 14 Optional metering, dual supply, surge protection and contactor on incoming
 - 15 Metered extension enclosures if not integral.
- L Metering: Provide standard option kWh meters for all boards that have an input power $\geq 20\text{kW}$ to allow the data to be picked up by the BMS/Energy monitoring system. Refer also to the distribution board schedule for other metering options which could be required:
 - 1 Standard,
 - 2 Meter ready
 - 3 Split metered
 - 4 Multiservice options.
- M Connect directly to earthing terminal without dependence on exposed conductive parts of enclosure
- N Identify each fuseway and MCB way by numbering
- O Identify each terminal on neutral busbar and earthing bar with its respective fuseway or MCB way
- P Provide spare ways, as shown on drawings/schedules
- Q Where specific ratings are indicated incorporate MCBs, otherwise leave ways blank for future additions.

V31.2.7 BATTERY AND CHARGER UNIT

- A Application: Where ACB protected switchgear is required to operate when switching from one source of supply to another (e.g. from normal to essential supply) provide a battery trip and charger unit to serve all the affected switchgear.
- B Comply with the general safety requirements of BS EN 50272-1.

C Performance characteristics:

- 1 Input Supply: 230V single phase 50 Hz.
- 2 DC Output
- 3 Voltage 30 Volt 20% +10%
- 4 Current as shown on drawings/schedules.
- 5 Operating temperature range 10°C to 45°C.

B Construction:

- 1 Charger type Thyristor or transistor
- 2 Battery type
- 3 Lead acid (sealed) or Nickel Cadmium (maintenance free).
- 4 Valve regulated
- 5 Standard: BS EN 61056-1, BS 6290-2, BS 6290-3
- 6 Cubicle (sheet steel): Wall mounted or Floor standing as shown on drawings/schedules
- 7 Cable entry: Top or bottom as shown on drawings/schedules
- 8 Finish Manufacturer's standard
- 9 Colour Manufacturer's standard
- 10 Ventilation Natural.

C Protection devices:

- 1 MCB input protection
- 2 Float charge
- 3 Battery over discharge protection
- 4 Fuses for battery protection
- 5 MCB's for outgoing circuits, as shown on drawings/schedules
- 6 Automatic selection of boost charge.

D Meters, indicators and alarms:

- 1 Meters: Provide for the following
 - a Battery voltage
 - b Charging current (dual scale for float and boost)
 - c Output current.
- 2 Lamp indications: Provide for the following:
 - a Supply on
 - b Supply fail (monitor input terminals)
 - c Float charge
 - d Boost charge
 - e No charge (when supply is on)
 - f Battery voltage low
 - g Battery voltage high.
- 3 Alarms (connected to operate a relay with shrouded 230V 3A a.c. or 0.5A d.c. N/C volt free contacts, closed on any alarm, for remote indication circuit)
 - a Supply failed
 - b No charge (when supply is on)
 - c Battery voltage low
 - d Battery voltage high.

V31.2.8 AUTOMATIC TRANSFER SWITCHES

A Application: Used for instantaneous automatic switching power between the primary and back up power sources

B Where indicated on the drawings supply and install automatic transfer switch (ATS) system(s) with number of poles, amperage, voltage, withstand and close-on ratings as shown on the schematic drawings. All automatic transfer switches and controllers shall be the products of the same manufacturer.

- C Each automatic transfer switch shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation.
- D All transfer switches shall be networked together and monitored from a central computer. Provide all necessary hardware, software, controls and cabling.
- E Programme all ATS units locally to provide a sequence control, such that under main supply failure the generator is not overloaded. The sequence and loads must be agreed with the generator manufacturer and Engineer. Upon main supply restoration the ATS units shall transfer the load back to the main supply in a safe controlled sequence. The contractor shall supply and install all network cabling and equipment necessary to ensure the ATS units are monitored at the central ATS computer.
- F Codes and Standards: The automatic transfer switches and controls shall conform to the requirements of:
- 1 Low Voltage Directive: BSEN 60947-6-1
 - 2 Class PC
 - 3 Utilization Category "A".
- G Automatic Closed-Transition Transfer Switches: Include the following functions and characteristics:
- 1 Fully automatic make-before-break operation
 - 2 Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms
 - 3 Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable
 - 4 Initiation occurs without active control of generator
 - 5 Controls ensure that closed-transition load transfer closure occurs only when the 2 sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.
 - 6 Failure of power source serving load initiates automatic break-before-make transfer.
- H Automatic Transfer-Switch Features:
- 1 Under voltage Sensing for Each Phase of Normal Source:
 - a Sense low phase-to-ground voltage on each phase
 - b Pickup voltage: adjustable from 85 to 100 percent of nominal
 - c Dropout voltage: adjustable from 75 to 98 percent of pickup value
 - d Factory set for pickup at 90 percent and dropout at 85 percent.
 - 2 Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals:
 - a Adjustable: 0-6 s
 - b Factory set: 1.0s.
 - 3 Voltage/Frequency Lockout Relay: Prevent premature transfer to generator:
 - a Pickup voltage: Adjustable from 85 to 100 percent of nominal
 - b Factory set: 90 percent.
 - 4 Pickup frequency:
 - a Adjustable from 90 to 100 percent of nominal
 - b Factory set for pickup at 95 percent.
 - 5 Time Delay: For retransfer to normal source: to automatically defeat delay on loss of voltage or sustained under voltage of emergency source, provided normal supply has been restored.
 - a Adjustable from 0 to 30 minutes
 - b factory set for 10 minutes.
 - 6 Test Switch: Simulate normal-source failure.
 - a Switch-Position Pilot Lights: Indicate source to which load is connected
 - b Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - Normal Power Supervision: Green light with nameplate engraved "Normal Source Available"
 - Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available".

- 7 Unassigned Auxiliary Contacts: For each switch position:
 - a Two normally open, single-pole, double-throw contacts
 - b Rating: 10 A at 240-V ac.
- 8 Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status
- 9 Engine Starting Contacts:
 - a One isolated and normally closed, and one isolated and normally open
 - b Rating: 10 A at 32-V dc minimum.
- 10 Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
- 11 Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals:
 - a Exercise cycle:
 - adjustable from 7 to 30 days
 - factory set: 7days.
 - b Running periods:
 - adjustable from 10 to 30 minutes
 - Factory set: 20 minutes.
 - c Cool down period:
 - adjustable from 10 to 30 minutes
 - Factory set: 5-minute cool-down period.
 - d Exerciser features include the following:
 - Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - Push-button programming control with digital display of settings.
 - Integral battery operation of time switch when normal control power is not available.

V31.2.9 AIR CIRCUIT BREAKERS

- A Provide Air Circuit Breakers where specified within the switchgear and as indicated on the drawings and schedules.
- B Where indicated in section B of this specification or on the drawings the ACBs are to be automatically controlled and monitored via the SCADA system. Provide within the LV panel, all necessary terminations and equipment for interfacing with the SCADA system.
- C ACBs to be complete with:
 - 1 Castell key type interlocks
 - 2 Restrictive earth fault protection
 - 3 Digital temperature meters monitoring:
 - 4 Transformer temperature on the ACB facia panel,
 - 5 Interfaced with the SCADA control system at each sub-station where indicated.
 - 6 Power logic meters.
 - 7 located on the ACB facia panel
 - 8 interfaced with the SCADA control system at each substation where indicated
 - 9 Automatic shutters: To cover all live contacts when circuit breaker is isolated, withdrawn or removed from housing
 - 10 A padlock to lock circuit breaker in isolated/withdrawn position, and to lock automatic shutters covering live contacts when removed from housing.
- D Construction:
 - 1 Manufacture: BS EN 60947-2
 - 2 AC Interrupting medium: Air

- 3 Number of poles - as shown on schedules/drawings
- 4 Utilisation category – B
- 5 Enclosure degree of protection - IP 31.

E Closing mechanism:

- 1 Independent manual spring operated
- 1 30V DC motor charged
- 2 The closing spring shall be automatically charged from the motor following a closing operation
- 3 The operating mechanism shall be provided with solid state, microprocessor-based releases consisting of protection unit and control unit.

F Characteristics:

- 1 Rated operational voltage: 690V AC
- 4 Rated insulation voltage: 1000V AC
- 5 Short circuit withstand current not less than 35kA RMS symmetrical for 3 seconds.
- 6 Frame size from 800A to 1600A.

G Bus couplers to be 4 pole ACBs having only overcurrent protection and shall be mechanically and electrically interlocked with incoming ACBs.

V31.2.10 MOULDED CASE CIRCUIT BREAKERS (MCCB)

A Provide MCCBs where specified and as indicated on the drawings and schedules

B Construction

- 1 All MCCBs shall comply with BSEN 60947-1,2,3
- 2 AC Interrupting medium – Air
- 3 Contacts: Quick make and quick break type with trip free mechanism ensuring full contact pressure until time of opening, whether actuated manually or automatically

C Tripping characteristics: Inverse time type secured through action of a combination of thermal magnetic trip elements which shall be trip free of the handle and operate in response to overloads or short circuits.

D MCCBs to be thermal magnetic type for ratings below 630A frame size, unless otherwise shown on drawings. MCCBs 630A and larger are to be electronic solid state, trip free type.

V31.2.11 FUSE SWITCHES

A Provide fuse switches where specified and as indicated on the drawings and schedules.

B Construction:

- 1 Manufacture: BSEN 60947-1&3
- 2 Fuse links: HRC and comply with BS88, or BSEN 60269
- 3 AC Interrupting medium: Air
- 4 Utilisation category: AC23
- 5 Fuse switches: 3 pole type with bolted neutral
- 6 Contacts: Quick make and quick break type ensuring full contact pressure until time of opening, when actuated manually.

C Provide the following features:

- 1 Contacts: Ensure contacts have a positive contact indication in the OPEN and CLOSED positions.
- 7 Fuse compartment: IP20 insulating covers
- 8 Interlock: to prevent access to the fuse when the switch is ON
- 9 Double isolation: Upstream and downstream of the fuse link when the switch is OFF
- 10 Operating handle: Padlock type for locking in the ON or OFF position.

V31.2.12 PROTECTION DEVICES INTERPOSING RELAYS AND INTER TRIPPING RELAYS

- A Application: Provide where indicated on the drawings and /or equipment schedules:
- 1 Manufacture: BS EN 60255-1
 - 2 Housing: Flush panel mounting type
 - 3 House all protection relays, excluding motor protection relays, in draw out cases
 - 4 Reset to be of the following type depending upon application:
 - a Interposing relays: Automatic reset type
 - b Inter-tripping relays: Manual reset type.
- B Overcurrent tripping device.
- C Provide overcurrent tripping device with over current characteristic similar to a BS 2692 high voltage cartridge fuse, sized to protect the equipment/load.

V31.2.13 VOLTAGE SENSING RELAYS

- A Provide single phase inverse time undervoltage type voltage sensing relays to monitor the voltage between respective phases of supply:
- 5 Mounting - Supply suitable for flush panel mounting with relay trip indication
 - 1 Voltage settings:
 - a 50% to 90% in five equal steps
 - b automatic resetting at 105% of voltage setting.
 - 2 Relay Inverse time characteristics
 - 3 When voltage increases from zero to rated voltage with time multiplier set at 1.0, set relay resetting times as follows:

a Relay setting %	50	60	70	80	90
b Resetting Time (secs)	2	4	5	10	12

V31.2.14 TRIP/CLOSE SWITCHES AND CONTROL SELECTOR SWITCHES

- A Provide a panel mounted heavy duty, spring return trip/close switch on each circuit breaker fitted with solenoid or motorised spring closing mechanisms.
- A Ensure contacts have a continuous rating of 10A minimum at between 30V to 250V ac and d and make and break duty rating of 30A at 250V ac or dc for a minimum period of 3 secs.
- B Provide a local/remote panel mounted selector switch to select circuit breaker for local or remote closing. Ensure that selection of remote or local closing does not prevent circuit breaker tripping under operation of local or remote trip switch or does not cause a trip incident.

V31.2.15 CURRENT TRANSFORMERS

- A Provide current transformers where required and for each protection device and instrumentation to comply with BS EN 61869-2.
- B Ensure current transformers provide appropriate accuracy and are compatible with over current factors, characteristics, performance and VA rating required for satisfactory operation of protection devices, instruments and meters indicated.
- C Ensure that current transformers are capable of withstanding maximum short time with stand current of value and duration indicated for assembly.
- D Provide test links in secondary connections of all current transformers to facilitate testing of instruments, meters and protection devices.

V31.2.16 INSTRUMENTS AND METERS

- A Standards:
- 1 General requirements: BS EN 60051-1(IEC 60051-1)

- 2 Ammeters and voltmeters: BS89-2 (EN 60051-2, IEC 60051-2)
 - 3 Wattmeters & Varmeters: BS 89-3: (EN 60051-3: IEC 60051-3:);
 - 4 kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters: BS EN 62053-11 and BS 8431.
- B Protect wiring to voltmeters by separate fuses.
 - C Protect potential coils of watt meters, frequency indicators, power factor indicators and kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters by separate fuses.
 - D Supply instruments and meters suitable for flush mounting and type, size and accuracy as indicated.
 - E Ensure that indicating scales for all instruments comply with BS 3693. Supply so that normal match day indication is 50% to 75% of full-scale deflection.
 - F Completely segregate all instruments in instrument compartments. Panel mount meters on front of instrument compartment.

V31.2.17 INDICATOR LIGHTS

- A Provide Indicator lamps on each LV board to indicate:
 - 1 Mains available (i.e. transformer live)
 - 2 Busbars Live (i.e. one per section indicating incoming LVU transformer supply or generator ACB closed)
 - 3 Generator supply available (at each of the LV boards essential section).
- B Supply lamps of same type throughout and comply with the following:
 - 1 Provide indicator lamps with lamp test facility
 - 4 Supply interchangeable indicators for respective units
 - 5 Protect wiring to indicator lamp units by separate cartridge fuses
 - 6 Lens Colour in accordance with BS EN 60073.

V31.2.18 POWER FACTOR CORRECTION

- A Make provision in the main LV panels for the future addition of (external to the panel) power factor correction equipment, this shall include space for CTs.
- B Only provide the power factor correction equipment (capacitors etc) within the LV panels where indicated on the drawings and schedules of equipment.
- C Refer to specification section V36 for details of static and automatic power factor correction equipment.

V31.2.19 HARMONIC FILTRATION

- A For all main LV panels make future provision to accommodate a filter bank to meet the requirements of Energy Networks Association (ENA) Engineering Recommendation G5/4 within each LV switchboard. Provide a switch in the switchboard for future use.
- B Only provide harmonic filters where indicated on the schedules and/or schematic drawings. For specification details refer to specification section V37.
- C The filter bank shall be installed in its own cubicle section, remote from the main board, with capacitor, block contactors and control gear sections connected back to back with reactor sections.

V31.2.20 SURGE PROTECTION

- A Application: Provide surge protection devices for protection of electronic equipment against induced surges and transient over voltages on computer networks, instrument systems, telephones and power lines etc:
 - 1 Main LV Switchboards/LV Switchgear: Install in cable termination compartments in each phase of circuit. Coordinate rating with circuit voltage
 - 2 Ensure surge protection devices protect electrical and electronic equipment and devices against indirect effects of lightning strikes and electrical faults

- 3 Provide surge protection devices in locations in circuits to protect vulnerable equipment and components without affecting normal operation. Ensure surge protection devices divert surge currents and safely 'clamp' transient over voltages
- 4 Provide devices which automatically reset, without damage, following any surge or transient etc. occurring
- 5 Ensure application of surge protection devices provides full system protection to all sections of circuits.
- 6 Provide surge protection devices at both ends of each protected circuit(s) when systems are interconnected, or field equipment is considered to be at risk
- 7 Ensure low resistance and low impedance earth connectors are provided to all surge protection devices, in accordance with manufacturers recommendations and requirements
- 8 Provide all earth cables and connections as short and direct as possible. Ensure all earthing arrangements are fixed and protected in accordance with the specification
- 9 Ensure all devices have BASEEFA certification. Provide for special considerations in hazardous area equipment and applications where surge protection is required.

B Surge Arresters:

- 1 Distribution class, metal-oxide-varistor type.
- 2 Comply with BS EN 61869-2:
- 3 Characteristics:
 - a SPD type: limiting voltage:
 - b Number of terminals: one
 - c Test classification acc. To BS EN 61643-11 - class II tests
 - d For system voltages up to 1 kV
 - e Location: outdoor and indoor
 - f Accessibility inaccessible (out of reach)
 - g Method of installation permanent (name plate "downwards")
 - h SPD disconnecting device located internally
 - i Ambient temperatures from -40°C to +70°C
- 4 Protection degree:
 - a IP 06 for standard execution
 - b IP 66 with insulated accessories
- 5 Nominal discharge current I_n 8/20 μ s: 5 or 10 kA (peak value)
- 6 Maximum discharge current I_{max} 8/20 μ s: 25 or 40 kA (peak value)
- 7 Limiting discharge current*: 40 kA or 65kA 4/10 μ s (requirement acc. to IEC 60099-4)
- 8 Voltage protection level U_p : acc. to guaranteed data table
- 9 Continuous operating voltage U_c : 280, 440, 500, 660, 800, 1000 V AC (effective value)
- 10 Energy absorption capability**: 4, 5 or 7 kJ / kV U_c (measured at one limiting surge 4/10 μ s)
- 11 Short-circuit withstand: 3 kA
- 12 Frequency: up to 62 Hz
- 13 Total creepage distance: 62 mm.

V31.2.21 SUPERVISORY CONTROL AND DATA ACQUISITION - SCADA

- A** Application: To provide a system for remote monitoring and control for switching and protection of the electrical distribution system. Provide where indicated in section B of this specification or as indicated on the drawings or equipment schedules.
- B** There are 3 major components of the SCADA system:
- 14 Master station: For remote monitoring
 - 15 Communications network: For Interconnection of master station with Remote terminal units
 - 16 Remote Terminal units: To monitor the status of the plant via digital and analogue inputs. Also provides control via circuit breakers and Automatic Transfer Switches.
- C** Minimum facilities required:
- 1 Collection of all data from LV switchboards:

- a Volts and current per phase
- b KW
- c KVA
- d KVAR
- e Power factor
- f Maximum Demand
- g KWhr
- h Frequency
- i Total Harmonic Distortion (current and voltage).
- 2 For all sub-meters where shown on schematics:
 - a Volts and current per phase
 - b KW
 - c KVA
 - d KVAR
 - e Power factor
 - f Maximum Demand
 - g KWhr
 - h Frequency
 - i Total Harmonic Distortion (current and voltage).
- 3 Logging: Log all alarm events. The following parameters shall be recorded via the mulit-meters
 - a At alarm pick-up
 - b Event type
 - c Date
 - d Time
 - e Most extreme reading during pick-up delay
 - f During alarm drop out:
 - g Date
 - h Time
 - i Most extreme reading during alarm event.
- 4 Control switching:
 - a Load shedding where required to minimise maximum demand
 - b Load shedding for operation on backup power
 - c Control of circuit breakers
 - d Control of automatic transfer switches.

D Configuration Requirements:

- 1 Secure Network
- 2 10 Year minimum life
- 3 Real time data acquisition (no delays)
- 4 Microsoft Windows server
- 5 Windows 7 or later
- 6 Pentium IV; 512MB RAM
- 7 120MB disc space; CD ROM
- 8 TCP/IP LAN Interface
- 9 SVGA or higher
- 10 Mouse.

E Display & Graphics

- 1 Multiple monitors per workstation
- 2 Windows style navigation
- 3 Object-orientated graphics
- 4 Industry specific object libraries
- 5 Pan, zoom with automatic declutter.

F Summary Lists: Provide the following:

- 1 Alarms
- 2 Events
- 3 Sequence of events
- 4 Dynamic database display
- 5 Control tag
- 6 Information tag
- 7 Manual override
- 8 Disabled alarms
- 9 Operator notes.

G Connectivity:

- 1 Multiple communications to RTUs, IEDs, PLCs or other I/O devices
- 2 Full OPC server and client support
- 3 Serial or Ethernet communication channels e.g. radio, GSM or GPRS.

H Safety Features:

- 1 Select before operate control
- 2 Control timeouts; control fail alarm
- 3 Simultaneous control lock-out
- 4 Control tagging (control lock-out)
- 5 Information tagging.

V31.2.22 LOW VOLTAGE COILS RATING

A Ensure coils for switching relays, contactors and other applications are capable of withstanding inherent voltage drop within system without armature or switching apparatus dropping out of position.

V31.2.23 FRAMEWORK

A Construct framework for supporting electrical equipment from mild steel plate and strip, cold and hot rolled steel sections or slotted angles, in accordance with BS EN 10210-2. Comply with BS EN 1011-2 for metal arc welding.

B Finish:

- 1 Frameworks mounted inside building
- 2 Zinc or Alu-zinc coated, and powder coated
- 3 colour as scheduled or manufacturer's standard finish.
- 4 Frameworks mounted outside building hot dip galvanised to BS EN ISO 1461.

C Supply cadmium or zinc-electroplated bolts, nuts, washers and screws.

V31.2.24 CABLE TERMINATIONS & IDENTIFICATION

A Ensure that switchgear and distribution boards are provided with facilities to terminate size, number and type of cables indicated in schedules. Note generator incomers may need to terminate several large multicore cables.

B Where necessary provide:

- 1 Fabricated steel extension boxes for glanding large and multiple cables
- 2 Non-ferrous metal glanding plates for single core cable terminations.

C Terminate XLPE SWA LSF and MICS cables inside enclosure by securing cables to switchboard with glanding plates or glanding brackets; and outside enclosure with glanding plates or fabricated steel extension boxes.

D Number terminals, cables and component parts to correspond with manufacturer's certified drawings.

E Materials: Refer to V80 "Electrical Identification". Identify units, devices, controls, terminals and wiring.

V31.2.25 SWITCHGEAR AND CONTROLGEAR ACCESSORIES

- A Provide switchgear and control gear accessories as shown on schedules and in addition provide:
- 1 Locks and padlocks, for each outgoing device
 - 2 Insulating mats to BS EN 61111 in front of LV switchgear
 - 3 Operating tools as necessary to enable operation of all switchgear supplied.

V31.2.26 MECHANICAL DISTRIBUTION BOARDS - DBM

- A All mechanical distribution boards (DBMs) supplying power to mechanical plant are to be constructed to the same constructional standards as MCPs (refer to section Y41)
- B Provide power consumption and monitoring facilities for each DBM as follows:
- 1 For each DBM: Where combined connected load is greater than 10kW provide a power meter to provide pulsed outputs to the BMS for:
 - a kWh
 - b amps per phase
 - c volts per phase
 - 2 For each outgoing feed greater than 5 kW provide a separate kWh meter for each power feed and monitor via the BMS
 - 3 For each outgoing feed greater than 20kW provide electric meters displaying:
 - Instantaneous power use kW
 - Amps per phase
 - Accumulative kWh and monitor via the BMS.

V31.3 PART 3 - EXECUTION

V31.3.1 EXAMINATION

- A Examine the areas and conditions under which switchgear is to be installed and correct any unsatisfactory condition detrimental to the proper and timely completion of work or advise the CA of any such detriment if not the responsibility of the installer.
- B Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the CA.
- C Ensure the layout and arrangement for each LV switchroom complies with all relevant Regulations, Standards and Codes.
- D Provide for equipment types, sizes, and specifications to be satisfactorily accommodated in each LV switchroom with regard for overall dimensions, clearances for safety and maintenance, weights, environmental factors and operating conditions etc.
- E Ensure all switchrooms also include space for future switchgear and equipment extensions.

V31.3.2 LV SWITCHBOARD INSTALLATION

- A Temporary Heating: Apply temporary heat to switchgear, according to manufacturer's written instructions, throughout periods when switchgear environment is not controlled for temperature and humidity within manufacturer's stipulated service conditions.
- B For floor mounted switchgear anchor switchgear assembly to 100-mm concrete base and attach by bolting:
 - 1 Concrete Bases:
 - a 100 mm high, reinforced, with chamfered edges
 - b Extend base no less than 75 mm in all directions beyond the maximum dimensions of switchgear, unless otherwise indicated.
- C Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchgear units and components.
- D Perform the following operations when assembly is in service and under voltage:
 - 1 Visual inspection of switching devices and other apparatus
 - 1 Settings and indicators of relays and releases
 - 2 Conductor connections and markings
 - 3 Adjusting and re setting of relays, releases and electronic devices
 - 4 Replacement of fuselinks and indicating lamps
 - 5 Fault location by voltage and current measuring.
- E Ensure that the following is provided for maintenance of the assembly:
 - 1 Space between functional unit or group and adjacent functional units or groups
 - 2 Removable fastening devices such as locks, screws, etc. for parts likely to be removed for maintenance.
- F Fix all equipment independently of wiring system. Use cadmium or zinc electroplated bolts, nuts, washers and screws. Refer to Y90.
- G Ensure that clearance in front of switchgear and control gear is not less than 1.2m, or as indicated.

V31.3.3 DISTRIBUTION BOARD INSTALLATION

- A Mount distribution boards so that they are readily accessible and fixed firmly to the building fabric by approved fixing, or to metal framework by nuts, bolts and washers, all in accordance with the Specification.
- B All distribution boards must be mounted in accessible areas and to be accessible without use of access equipment. All distribution boards are to be fitted with locks.

- C Ensure all terminations are fully shrouded. Access to busbars and cabling terminals shall only be by removal of fixed screwed cover plates.
- D Provide distribution boards complete with lockable hinged front covers (side hinge only) to provide access to, fuses, MCBs and RCDs for maintenance and switching. Fix circuit charts inside each distribution board.
- E Ensure distribution boards shown without local isolating switches are supplied complete with integral two or four pole mains isolator with cable terminations sized to accommodate the specified supply cables.
- F Ensure that adequate provision is made within the distribution board to receive the specified cabling and that the boards are physically sized to suit the proposed installation location.
- G Ensure ingress protection is a minimum of IP31 rating and that all cable entries into the board maintain this protection rating.
- H Provide all distribution boards complete with fully rated neutral and earth termination with one neutral and earth connection for each single-phase output distribution way.
- I Provide distribution boards with adequate earth termination facilities to accommodate the equipotential and supplementary earth requirements for each particular project.

V31.3.4 AUTOMATIC TRANSFER SWITCH INSTALLATION

- A Always mount the equipment in accordance with the manufacturer's instructions
- B Testing:
 - 1 Test the operation of the transfer switches when carrying out the generator commissioning
 - 2 Provide the services of a manufacturer certified specialist to supervise the installation, make adjustments, and perform tests on the automatic transfer switches and to train Employer's personnel.
- C Start-up checklists: Perform the following final checks before Start-up:
 - 1 Visually inspect the systems
 - 2 Ensure the terminations are tight and all ancillary equipment completely installed
 - 3 Ensure all overloads are in place
 - 4 Measure contact resistance.
- D Starting Procedures: Follow the manufacturer's written procedures and the following as a minimum:
 - 1 Energize Switch
 - 2 Check positive interlock between systems
 - 3 Set/Calibrate Voltage sensing relay, transfer time delays (in both directions), and synchronization relays
 - 4 Measure insulation resistance and resistance to ground
 - 5 Check manual bypass operation.

V31.3.5 LV SWITCHBOARDS INSPECTION AND TEST PROCEDURES

- A Install and commission switchgear and control gear/SCADA system in accordance with the appropriate standard and the manufacturer's recommendations.
- B Factory Test: Provide certificates of verification for all main LV switchboards. Each board to be factory built and fully type tested to BS EN 61439-1. Only KEMA or ASTA certified switchboards will be accepted.
- C Include the following checks in both factory and site commissioning tests:
 - 1 CT Polarity
 - 2 Primary injection test for all C.B's and meters (Factory only)
 - 3 Secondary test for all protective relays
 - 4 Millivolt drop test.
 - 5 Insulation test
 - 6 Functional test

- 7 Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit
 - 8 Test continuity of each circuit.
- D Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
- 1 Inspect switchgear installation, including wiring, components, connections, and equipment. Test and adjust components and equipment
 - 2 Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Y61 "LV and ELV Cables"
 - 3 Complete installation and startup checks according to manufacturer's written instructions
 - 4 Assist in field testing of equipment including pretesting and adjusting of equipment and components
 - 5 Report results in writing.
- E Perform the following field tests and inspections and prepare test reports:
- 1 Perform each visual and mechanical inspection and electrical test stated in BS EN 60439 and as required by local Utility company regulations. Certify compliance with test parameters. Perform BS EN 61439 tests and inspections for each of the following categories:
 - a Switchgear
 - b Circuit breakers
 - c Protective relays
 - d Instrument transformers
 - e Metering and instrumentation
 - f Ground-fault systems
 - g Battery systems
 - h Surge arresters
 - i Capacitors.
 - 2 Remove and replace malfunctioning units and retest as specified above.
- F Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchgear/main LV switchboard. Remove front and rear panels so joints and connections are accessible to portable scanner:
- 1 Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchgear 11 months after date of Substantial Completion
 - 2 Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device
 - 3 Record of Infrared Scanning: Prepare a certified report that identifies switchgear checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- G All switch tests shall be witnessed by the CA or his representative or shall be carried out by independent testing authorities and test certificates shall be forwarded to the CA.

V31.3.6 IDENTIFICATION

- A Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in V80 "Electrical Identification".
- B Diagram and Instructions:
- 1 Frame and mount under clear acrylic plastic on the front of bus assemblies:
 - 2 Operating Instructions: Printed basic instructions for bus assemblies
 - 3 System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads.
 - 4 Storage for Maintenance: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

V31.3.7 CONNECTIONS

- A Earth equipment according to V81 "Earthing and Bonding Systems".
- B Connect wiring according to Y61 "LV and ELV Cables".

V31.3.8 FIELD QUALITY CONTROL

- A Prepare for acceptance tests as follows:
 - 1 Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit
 - 2 Test continuity of each circuit.
- B Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
 - 1 Inspect switchgear, wiring, components, connections, and equipment installation. Test and adjust components and equipment
 - 2 Assist in field testing of equipment including pretesting and adjusting of automatic power factor correction units
 - 3 Report results in writing.
- C Perform the following field tests and inspections and prepare test reports in compliance with specification Y50 Testing and Commissioning of Mechanical and Electrical Services:
 - 1 Perform each electrical test and visual and mechanical inspection stated in Y50. Certify compliance with test parameters. Perform tests and inspections for each of the following categories:
 - a Switchgear
 - b Circuit breakers
 - c Protective relays
 - d Instrument transformers
 - e Metering and instrumentation
 - f Ground-fault systems
 - g Battery systems
 - h Surge arresters
 - i Capacitors.
- D Remove and replace malfunctioning units and retest as specified above.
- E Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each switchgear. Remove front and rear panels so joints and connections are accessible to portable scanner:
 - 1 Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchgear 11 months after date of Substantial Completion
 - 2 Instrument: Use an infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device
 - 3 Record of Infrared Scanning: Prepare a certified report that identifies switchgear checked and that describes infrared-scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

V31.3.9 CLEANING

- A On completion of installation, inspect interior and exterior of switchgear. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

V31.3.10 DEMONSTRATION

- A Engage a factory-authorized service representative to train Employer's maintenance personnel to adjust, operate, and maintain switchgear. Refer also to Section A for details.

V80 ELECTRICAL IDENTIFICATION

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V80.1 PART 1- GENERAL

V80.1.1 RELATED DOCUMENTS

- A For drawings and general provisions of the Contract refer to the main Contract Preliminaries and section A of this specification.
- B For system descriptions, operating conditions and ambient temperatures refer to section B of this specification and section D the Schedules of Equipment.
- C Refer also to all other sections including the following:
- 1 V30 "Low Voltage Distribution Systems"
 - 2 V31 "Low Voltage Switchgear"
 - 3 V81 "Earthing and Bonding Systems"
 - 4 V85 "Electrical Testing and Inspection".
 - 5 Y41 Building Monitoring and Management
 - 6 Y50 Electrical Commissioning
 - 7 Y60 Conduit and Trunking
 - 8 Y61 LV and ELV Cables
 - 9 Y63 Cable Supports
 - 10 Y90 Fixing to Building

V80.1.2 SUMMARY

- A This section covers the provision of
- 1 warning and safety signs for all electrical equipment rooms.
 - 2 Signs and labels for identifying electrical plant, equipment and cabling systems
- B All plant and equipment is to be identified with a unique reference number with type description relating to the references used in the record drawings.
- C Identify the nature of all services by the use of colour coded bands/sheaths and appropriate signage.
- D Section Includes requirements for:
- 1 Safety Notices
 - 2 Warning signs
 - 3 Equipment labelling
 - 4 Identification for conduits and trunking
 - 5 Identification of power and control cables
 - 6 Identification for conductors
 - 7 Underground cables and ducts warning notices and tape
 - 8 Instruction signs
 - 9 Miscellaneous identification products.

V80.1.3 DEFINITIONS

- A The following acronyms are used in this specification:
- 1 A.C.: Alternating Current
 - 2 ACB: Air Circuit Breaker
 - 3 ATS: Automatic Transfer Switches.
 - 4 D.C.: Direct Current
 - 5 ELV: (Extra Low Voltage):
 - a A.C.: <50V
 - b D.C. <120V ripple-free

- 6 HV (High Voltage): Voltage $\geq 35\text{kV}$ but for this document also includes MV
- 7 IET: Institution of Engineering and Technology
- 8 LEDC: Local Electrical Distribution Company
- 9 LV (Low Voltage): Voltage
 - a A.C.: $\geq 50\text{V}$ and $\leq 1000\text{V}$ or 600V between conductors and earth
 - b D.C.: 1500V between conductors or 900V between conductors and Earth
- 10 LSF: Low Smoke and Fume.
- 11 LSZH/LSOH: Low Smoke Zero Halogen
- 12 MCC: Motor Control Centre.
- 13 MV (Medium Voltage): Voltage $\geq 1.0\text{kV}$ and $\leq 35\text{kV}$ referred to as HV in this document
- 14 rh: relative humidity
- 15 SCADA: Supervisory Control and Data Acquisition.
- 16 XLPE: Crosslinked Polyethylene.

V80.1.4 PERFORMANCE REQUIREMENTS

- A All plant, equipment and services to be clearly labelled in English/National symbols to denote the function of the plant or the service being conveyed.
- B Labelling applies to all new and modified systems only. Any existing system which does not have the appropriate labelling must be identified to the CA.
- C Comply with the requirements for labels, notices and warning signs as identified in:
 - 1 BS 7671+A3 (Requirements for Electrical Installations –IET Wiring Regulations)
 - 2 After July 2018: BS 7671.2018.
 - 3 For Hospital projects: HTM06
 - 4 Local Utility Company regulations
- D Provide labels and notices as required and local wiring Regulations and provide:
 - 1 Identification of protective devices
 - 2 Warning notices and labels for:
 - a LV systems and equipment
 - b HV/MV systems and equipment
 - c substation doors
 - d Gas suppression systems and associated control equipment
 - e Warning notices and labels for all HV and LV distribution rooms
 - f Life Safety equipment
 - 3 Periodic inspection and test notices
 - 4 Residual current device notices
 - 5 Earth electrode safety electrical connection label
 - 6 Bonding conductor connector points to extraneous conductive parts label
 - 7 Earth free local equipotential bonding areas warning notice
 - 8 Electrical separation areas warning notice
 - 9 Outdoor equipment socket outlet notice
- E Equipment labels and isolator labels must indicate the circuit reference and where they are fed from.
- F All access doors to plant areas or items of plant to include signage highlighting the potential risks within. All machinery likely to cause harm or injury shall be marked accordingly. All safety signage shall be in accordance with BS EN ISO 7010.
- G HV& LV substations should include the following notices/features as a minimum :
 - 1 Warning notices
 - 2 safety posters as required by regulatory authorities including first aid/electric shock treatment;
 - 3 single line schematic diagrams;

- 4 a mimic diagram (where indicated necessary);
 - 5 a sign positively identifying the LV earthing system;
- H Note that a sign positively identifying the LV earthing system should also be located at each final distribution board, motor control centre and similar locations.

V80.1.5 SUBMITTALS

- A Product Data: For each electrical identification product indicated.
- B Samples: For each type of label and sign to illustrate size, colours, lettering style, mounting provisions, and graphic features of identification products. Samples to include:
- 1 Warning Sign
 - 2 Safety Sign
 - 3 Schematic Diagram
- C Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

V80.1.6 QUALITY ASSURANCE

- A Ensure that the design, construction, materials and finishes of all equipment are suitable for the location, climatic and operating conditions to which the installation shall be exposed.
- B Ensure that the whole installation complies with the relevant standards, including the following:
- 1 BS 3858: Specification for binding and identification sleeves for use on electric cables and wires
 - 2 BS 5472 – (EN 50005): Specification for low voltage switchgear and control-gear for industrial use. Terminal marking and distinctive number. General rules
 - 3 BS 6272 – (ISO 50042): Specification for low voltage switchgear and control-gear for industrial use. Terminal marking. Terminals for external associated electronic circuit components and contacts
 - 4 BS 5252: Framework for colour co-ordination for building purposes. British Standards Institution, 1976.
 - 5 BS 5499-10: Safety signs including fire safety signs. Code of practice for the use of safety signs, including fire safety signs
 - 6 BS 6701 +A1: Telecommunications equipment and telecommunications cabling. Specification for installation, operation and maintenance
 - 7 BS 7671+A3: Requirements for electrical installations. IET Wiring Regulations.
 - 8 BS 7671: 2018 from July 2018 18th edition IET wiring regulations
 - 9 BS EN 60034-8 + A1: Rotating electrical machines. Terminal markings and direction of rotation.
 - 10 BS EN 60073: Basic and safety principles for man-machine interface, marking and identification. Coding principles for indicators and actuators
 - 11 BS EN 60445: Basic and safety principles for man-machine interface, marking and identification. Identification of equipment terminals, conductor terminations and conductors
 - 12 BS EN 61439: all parts: Low-voltage switchgear and control-gear assemblies
 - 13 BS EN ISO 7010 + A7: Graphical symbols. Safety colours and safety signs. Registered safety signs
 - 14 BS ISO 3864-1: Graphical symbols. Safety colours and safety signs. Design principles for safety signs and safety markings
 - 15 BS ISO 17398: Safety colours and safety signs. Classification, performance and durability of safety signs.
- C Ensure that signage and identification is provided in accordance with the following Acts and Regulations
- 1 Confined Spaces Regulations 1997.
 - 2 Construction (Design and Management) Regulations
 - 3 Construction (Design and Management) (Amendment) Regulations 2000.
 - 4 Electricity at Work Regulations 1989.
 - 5 Electricity Safety, Quality and Continuity Regulations 2002
 - 6 Electromagnetic Compatibility Regulations 1992.

- 7 Health and Safety (Safety Signs and Signals) Regulations 1996.
- 8 Health and Safety at Work etc Act 1974.
- 9 Health and Safety (First-aid) Regulations 1981
- 10 Management of Health and Safety at Work Regulations 1999.
- 11 Workplace (Health, Safety and Welfare) Regulations 1992.

V80.1.7 CO-ORDINATION

- A Co-ordinate identification names, abbreviations, colours, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards. Use consistent designations throughout Project.
- B Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C Coordinate installation of identifying devices with location of access panels and doors.
- D Install identifying devices before installing ceilings and similar types of concealment.

V80.2 PART 2 – PRODUCTS

V80.2.1 EQUIPMENT IDENTIFICATION

A Within Buro Happold a standardised method of equipment referencing has been set up. Use this referencing system for labelling equipment unless an alternative project specific system has been adopted and approved by the CA.

B This labelling standard comprises 3 components:

- 1 Equipment Type Reference Acronym
- 2 Floor or zone reference
- 3 Unique identifier



For example, Lighting Control Panel No. 6 on level 13 would be:

LCP - 13 - 06

C Standard Electrical Equipment Acronyms are given in the table below:

GENERATOR	GEN
TRANSFORMER	TX
SUB-MAIN DISTRIBUTION BOARD	SMDB
DISTRIBUTION BOARD	DB
DISTRIBUTION BOARD LIGHTING	DBL
DISTRIBUTION BOARD POWER	DBP
DISTRIBUTION BOARD EMERGENCY	DBEM
DISTRIBUTION BOARD MECHANICAL	DBM
MAIN LV PANEL	MLVP
MAIN HV PANEL	MHVP
MAIN MV PANEL	MMVP
UNINTERRUPTIBLE POWER SUPPLY SWITCHBOARD	UPSS
CENTRAL BATTERY	CB
MECHANICAL CONTROL PANEL	MCP
MECHANICAL CONTROL CENTRE	MCC
PLANTROOM CONTROL PANEL	PCP
OUTSTATION CONTROL PANEL	OSCP
BUSBAR	BUS
LIGHTING CONTROL PANEL	LCP
AIR TRANSFER SWITCH	ATS
POWER FACTOR CORRECTION	PFC
MINIATURE CIRCUIT BREAKER	MCB
MOULDED CASE CIRCUIT BREAKER	MCCB

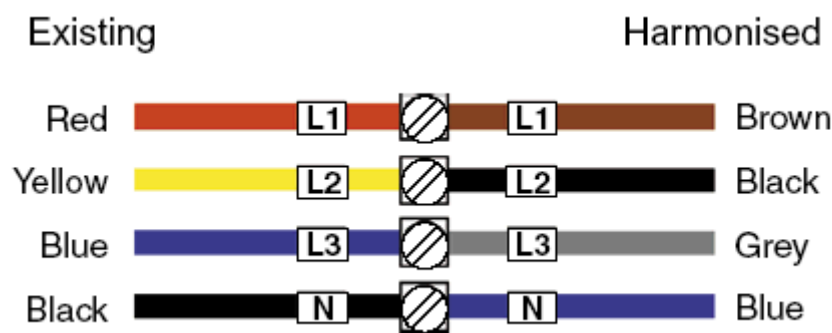
D For distributed electrical services the following acronyms are used

ELECTRICAL DISTRIBUTION	
HV	High Voltage in excess of 1kV and $\leq 35\text{kV}$
MV	Medium Voltage in excess of 1kV and $\leq 35\text{kV}$
LV	Low Voltage 50-1000V AC or 1500V DC
ELV	<50V AC or < 120V DC ripple free
ATS	Automatic Transfer Switch
MCC	Motor Control Centre
RCD	Residual Current device
SPN	Single phase and neutral
TPN	Three Phase and Neutral
CPC	Circuit Protective Conductor
AC	Alternating Current
DC	Direct Current
DB	Distribution Board
MCB	Miniature circuit breaker
MCCB	moulded-case circuit breaker
PEC	Protective earth conductor
PF	Power factor
RMU	Ring main Unit
UPS/Lighting Controls	
UPS	Uninterruptible power Supply
Fire Alarm/Public Address	
FDAS	Fire Detection and Alarm System
FACP	Fire Alarm Control Panel
FARP	Fire Alarm Repeater Panel
VA	Voice Alarm
PA	Public Address
AFILS	Audio Frequency Induction Loop Systems
BMS	Building Management System
GES	Gaseous Extinguishing system

V80.1.1 CABLE IDENTIFICATION

E Provide all cables (other than final sub-circuit wiring enclosed in conduits or trunking), with labels fixed at each end of cable, at either side of wall and floor penetrations and at approximately 12m intervals at convenient inspection points by means of non-releasable plastic straps, minimum width 4mm.

- F Ensure labels show the reference number of cable.
- G Identify cable conductors in accordance with BS 7671+A3 (IET Wiring Regulations) or BS 767:2018 after July 2018. Note that a lighting sub-circuit switch wire is a phase conductor in a single-phase circuit.
- H All single phase final sub-circuit phase wiring shall be coded Brown.
- I Ensure that all mechanical and electrical equipment installed also complies with these requirements to ensure no ambiguity between the equipment and the wiring installations. It will not be permitted to identify equipment or wiring colours using identification tape or markers.
- J For **alterations or extensions** to 3-phase installations, mark all old and new cables at the interface "L1", "L2" and "L3" for the phases and "N" for the neutral (see diagram below). The marking should be made to both the old and the new cables in an approved propriety permanent marking system and coloured tape shall not be used. A caution notice shall be fixed to the relevant distribution board.



- K If written approval is obtained from the CA prior to installation, where there are amendments to existing wiring within a defined area which uses the red/yellow/blue/black and green/yellow cable colours and this wiring is to be retained, the new wiring within these areas may match the existing cable colours.

V80.2.2 CIRCUIT IDENTIFICATION

- A The NICEIC (National Inspection Council for Electrical Installation Contractors) recommend within distribution boards that the circuit number comes first and then the phase identification for example:
- 1 circuit 6 brown phase is marked: **6L1**
 - 2 circuit 8 black phase is marked: **8L2**
 - 3 circuit 10 grey phase is marked: **10L3**
 - 4 circuit 7 blue (neutral) is marked: **7N**
- B Single phase circuits: Circuit identification on drawings identifies the source by the first acronym. So using the above examples for single phase circuits:
- 1 circuit 6 on Lighting Distribution Board No.10 on level 3: **DBL-03-10/ 6L1**
 - 2 circuit 8 on Power Distribution board No. 6 on level 2: **DBP-02-06/ 8L2**
 - 3 circuit 10 on Lighting Control Panel No 2 on ground floor: **LCP-00-02/10L3**
 - 4 circuit 7 on mechanical distribution board No. 3 on level 67: **DBM-67-03/7/N**
- C Three-phase circuits should be numbered in a similar manner:
- 1 circuit 8 on Power Distribution Board No.6 on level 2: **DBP-02-06/ 8L1L2L3**
 - 2 cable feeding Submain Distribution Board No. 01 on level 3
fed from Main MV panel No.3 at ground level from transformer
No 2 also at ground level **TX-00-02/ MMVP-00-03/ SMDB-03-01**

- D In addition, the circuiting referencing should follow that used in the electrical calculation package used so that there is complete correlation from the calculations to the actual installed cables. Most acceptable calculation packages do use the above system.

V80.2.3 SAFETY SIGNS GENERAL

- A Provide safety signs in accordance with the IET wiring regulations, any additional project specific requirements, requirements of the DNO and to comply with statutory regulations.
- B Safety signs fall into 2 categories:
- 1 Temporary signs for use during installation
 - a Caution sign
 - b Danger sign
 - 2 Permanent signs for completion of the installation
 - a Warning sign
 - b Switchroom sign
 - c Mimic diagram
- C **Caution Sign:** This is a temporary, non-metallic sign bearing the following words at the point of isolation:
- 1 "caution – persons working on equipment" and
 - 2 "do not touch"
- D **Danger sign:** This sign is a temporary, non-metallic sign bearing the words and used where there is adjacent live equipment at the place of work
- 1 "danger live equipment" and
 - 2 "do not touch" which is to be.
- E **Warning sign:** This sign is a permanent, non-metallic sign bearing the words:
- 1 "danger of death" or may be a combined warning sign and notice. The relevant voltage, if in excess of low voltage, should be displayed below the words "danger of death" in black letters and in the same letter size.
- F **Switchroom sign:** This is a permanent, non-metallic sign bearing the words
- 1 "electrical switchroom" and
 - 2 "no unauthorised access".
- G **Mimic diagram:** a single line diagram of an electrical distribution system so made that the symbol for each item of switchgear may be adjusted to indicate the "on", "off" or "earthed" positions.

V80.2.4 SIGNAGE, NOTICES AND LABELLING - HV & LV SWITCHROOMS

- A Posters: Display, prominently in each switch room containing high voltage and LV electrical equipment, the following posters:
- 1 a single line drawing of the high voltage system up to and including final circuit distribution boards under the control of the Authorised Person (HV);
 - 2 if the room contains equipment containing sulphur hexafluoride, a notice stating this should be displayed.
- B Provide Statutory warning electricity safety signs as required by and to the proportions given. in the Electricity Safety, Quality and Continuity Regulations 2002.
- C Design and colours of the signs should be to BS EN ISO 7010: +A7: Graphical symbols. Safety colours and safety signs. Registered safety signs
- D Provide warning signs on any pole that supports high voltage conductors or equipment.

E Provide Warning notices, Safety Signs, Mimic Diagrams, and Schematic Diagrams for all HV&LV equipment rooms as detailed below.

F **Warning Notices:** Provide on electrical plantroom doors containing high voltage electrical equipment including switchroom doors, substation doors, main distribution boards and where required in LV rooms to comply with statutory regulations and IET wiring regulations.

- 1 Identify each substation and main switch-room with safety signs and supplementary signs to BS EN ISO 7010 and notices and signs required by for any fire extinguishing system. The notice is to give details of:
 - a Name of the substation or switch-room
 - b The presence of high/medium and low voltages
 - c Administrative instructions for access
 - d Location and method of contacting controlling authority
 - e Actions to be taken in an emergency.
- 2 comply with table 11C of the Electricity Safety, Quality and Continuity Regulations, which requires duty-holders to erect three types of notice at substations:
 - a one or more "danger of death" safety signs complying with Schedule 1 of the Regulations;
 - b a property notice giving the unique identification number or location of the substation and an emergency telephone number. Each property notice must carry the name of the substation's current owner or operator.
 - c where necessary, other signs commensurate with the risk of interference, for example "keep out" signs.

The quantity, size and position of signs should be appropriate to the risk of danger from interference at each location.
- 3 Provide gas extinguishing signage if gas flooding systems are installed.
- 4 The notice giving the unique identification number or location of the substation should also be displayed within the substation adjacent to the single line diagram.
- 5 If the room contains equipment containing sulphur hexafluoride, a notice stating this should be displayed.

G **Safety Signs:** Provide permanent safety signs, securely and permanently fixed in accordance with the clauses in this section and include where appropriate:

- 1 The Electricity at Work Regulations 1989;
- 2 A poster showing an approved method of treatment for electric shock;
- 3 Other relevant health and safety information.

H **Mimic Diagrams:** A glass covered or electronic mimic diagram to be provided for any high voltage distribution system that includes a ring circuit, an automatic start generating set or a fixed uninterruptible power supply and where indicated on the drawings. Construct Mimic diagram as follows:

- 1 The symbol for each item of switchgear may be adjusted to indicate the "ON", "OFF" or "EARTHED" positions.
- 2 The mimic diagram should be only adjusted by an Authorised Person and should conform to the following:
 - a A single line diagram indicating all high voltage circuits comprising the high voltage system, together with any low voltage interconnecting circuits that can back feed to the high voltage system (that is, generators, UPS systems etc);
 - b Fully detailed with switch, circuit breaker, transformer, generator, and UPS etc
 - c Symbols to comply with the requirements of BS EN 60617.
 - d The switching equipment symbols should incorporate the facility to indicate whether the switch contacts are open, closed or earthed;
 - e An accurate representation of the system, with all switching devices shown in their relative positions;
 - f Drawn to show all equipment and switching devices, clearly and correctly labelled;
 - g Totally enclose the mimic diagram within a cabinet complete with:
 - full-width transparent doors

- integral lock.

- I **Schematic Diagrams:** Provide in each room containing HV or LV switchgear a purpose made schematic diagram permanently fixed in a suitable location.
- 1 Description: A single line drawing of the whole system (up to final distribution boards) showing all HV and major LV equipment in its normal state of operation
- J **Labelling:** Provide labels for all electrical plant and equipment using safety signs of BS EN ISO 7010 where voltages above ELV exist. Provide supplementary or text signs complying with BS EN ISO 7010 with each safety sign as indicated.
- K **Signs - Construction:** The design and construction of the signs should conform to the following:
- 1 Use materials for labels and notices with a predicted life equal to or greater than the design life of the electrical cables, plant, equipment or installation to which it refers and to BS ISO 17398.
 - 2 Design Standards: For dimensions, layouts, construction standards, and colours refer to:
 - a BS EN ISO 7010
 - b BS ISO 3864
 - 3 Materials: Laminated plastic or other similar non-metallic weather resistant material (thickness appropriate to the intended location and application).
 - 4 Non-corrosive materials are to be used when fixing permanent safety signs.
 - 5 Permanent signs should not be fixed with adhesives.
 - 6 Obtain approval prior to manufacture, with regard to style, colour, lettering, size and position of all labels and notices.
- L Lettering and size of labels and notices: Ensure that all lettering and symbols comply with the requirements laid out in
- 1 BS 7671 IET Wiring Regulations
 - 2 BS EN ISO 7010.

V80.2.5 PLANT AND EQUIPMENT LABELS

- A Labels General: Fit traffolite (acrylic engraving laminate) labels on all items of plant, equipment, switches, motors, starters, with letters a minimum of 6mm black on a white background:
- B For outgoing and incoming circuits include the following information
- 1 service controlled
 - 2 circuit reference
 - 3 voltage
 - 4 type of supply and phase etc
 - 5 circuit protection type and rating.
- C Maintenance Notices:
- 1 Fix notices giving warning of, and instructions for, any special maintenance procedures to plant and equipment.
- D Colour Corrected Light Fittings:
- 1 Fix a warning or identification disc to light fittings containing colour corrected fluorescent tubes or other colour corrected light sources to ensure that maintenance staff install the correct lamps.
- E Motors and Starters Labels:
- 1 Fit identification labels to all motors, starters and starter panels.
 - 2 Ensure positive identification of respective motors and starters.
 - 3 Provide motors with non-corrodible labels attached adjacent to each bearing giving details of the lubricant to be used.

- 4 Mark direction of normal rotation on motor casing.
 - 5 Provide labels to identify motor equipment fitted with surge suppressors and thermistors stating that insulation test voltages must not be applied to thermistors and thermistor control units.
 - 6 Ensure labelling is compatible with schematic and wiring diagrams and complies with BS EN 60034-8.
- F Engraved Accessory Plates: Engrave the following using 6mm high letters with engraving coloured red. Refer also to section Y65:
- 1 Switch-plates
 - 2 spur units
 - 3 pushes and special plates for bed head units
 - 4 call systems
 - 5 fire alarms, etc.
- G Switchgear: Fit labels on switchgear as required by BS 7671+A3 or from July 2018 BS 7671:2018 and BS EN 60439 to indicate the following. Refer also to:
- 1 duty of unit
 - 2 voltage, phase and current rating
 - 3 protective device rating size of conductor involved
 - 4 all other necessary details
 - 5 Use an agreed serial coding system
 - 6 provide at the switch a key to the coding system.

V80.2.6 DISTRIBUTION BOARDS

- A Provide in each distribution board identify every outgoing way with a renewable circuit chart in a transparent plastic envelope permanently fitted inside distribution board cover. Clearly indicate in typed script, circuit identification number, cable size, fuse or circuit breaker rating and a description of item supplied, and area supplied by circuit.

V80.2.7 SPECIAL PURPOSE EARTHING

- A Fit labels to special purpose earthing conductors and connection points, describing their purposes and any instructions necessary for their operation and maintenance:
- 1 IT equipment "Clean Earths"
 - 2 Telecommunications functional earths.

V80.2.8 CONDUIT AND TRUNKING COLOUR CODING

- A In areas of mechanical plant or voids accommodating mechanical services, or where otherwise indicated, identify electrical conduits and ducts in accordance with BS 1710. Apply colour orange to BS 4800 by painting on service as a band over 150mm or applying an adhesive tape type wrap around services over a length of 150mm.
- B Place identification colours at bulkheads, wall penetrations and any other place where identification is necessary.

V80.2.9 TERMINAL MARKING AND CONDUCTOR IDENTIFICATION

- A Provide for switchgear and control gear elements whose terminals are marked in accordance with BS 5472 (EN 50005) and BS 6272 (EN 50042):
- 1 Use a unique reference to identify each element in the switchgear or control gear
 - 2 Mark on or adjacent to each element its reference

- 3 Identify each terminal for connection to external wiring or cabling using a reference system complying with BS EN 60445 based on the element reference and the appropriate element terminal reference.

B Adjacent to terminals:

- 1 Use lettered or numbered ferrules or sleeves to BS 3858
- 2 Mark each auxiliary conductor or control cable core with the identity of the terminal to which it is connected
- 3 Include:
 - 4 the reference of plant or equipment to which it is connected
 - 5 the identity of the terminal at the remote end
- 6 Ensure that main circuit conductors are identified in accordance with Local Wiring Regulations
- 7 Ensure that all identification of terminals and conductors is recorded and included on record drawings and in operation and maintenance documentation.

V80.2.10 UNDERGROUND CABLE IDENTIFICATION

A For detailed requirements for the identification of underground cables and ducts refer to section P30 of this specification

V80.2.11 CABLE SHEATH IDENTIFICATION

A Internal: Identify coloured cables sheaths for various services as follows:

- 1 Fire alarm: Red
- 2 Emergency Lighting: White
- 3 Clock circuits: Brown
- 4 Telecommunication: Grey
- 5 Data: As system suppliers' requirements
- 6 Control: black
- 7 Power LV: black
- 8 Power Lighting: White
- 9 LV: mineral insulated - orange
- 10 HV: Red.

B Code cables for various services using alpha numeric symbols as follows. Code letters preceding cable reference:

- 1 Fire alarm: FA
- 2 Clock: CL
- 3 Telecommunications: T
- 4 Data: D
- 5 Control: C
- 6 Low voltage: LV
- 7 Extra low voltage: ELV
- 8 LV Essential circuits: E
- 9 Medium voltage: HV

V80.2.12 EXTERNAL

A Identify cable sheaths for various services in accordance with NJUG4, as follows:

- 1 HV: Red
- 2 LV: Black
- 3 Telecommunications and data: Grey.

V80.2.13 EXTERNAL, SCOTLAND

A Identify cable sheaths for various services in accordance with NJUG4, as follows:

- 1 HV: Red
- 2 LV: Purple
- 3 Telecommunications and data: Grey.

V80.2.14 ADDITIONAL SAFETY SIGNS

A Provide at locations shown or as appropriate safety signs to BS EN ISO 1710. Comply with the following guidance:

- 1 HSE: L64: The health and Safety (Safety Signs and Signals) Regulations 1996
- 2 HSE: L22: Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance L22 (Fourth edition)
- 3 HSE: L25: Personal protective equipment at work (Second edition). Personal Protective Equipment at Work Regulations 1992 (as amended). Guidance on Regulations L25(Second edition)
- 4 Health and Safety (Safety Signs and Signals) Regulations 1996 SI 1996/341 The Stationery Office
- 5 Health and Safety at Work etc Act 1974 The Stationery Office 1974 www.legislation.gov.uk

A Apply identification labels and notices in accordance with Local Wiring Regulations and BS 7671+A3 (IET Wiring Regulations) clause 514 and BS 7671:2018 from July 2018 to all electrical cables plant and equipment including components of mechanical systems. Include the following Labels and Notices

- 6 Identification of protective devices
- 7 Diagrams, charts or tables to comply with Clause 514-09 of BS7671+A2
- 8 Warning notices, voltages in excess of 230 volts
- 9 Periodic inspection and test notices
- 10 Residual current device notices
- 11 Earth electrode safety electrical connection label
- 12 Bonding conductor connector point to extraneous conductive parts label
- 13 Earth free local equipotential bonding areas warning notice
- 14 Electrical separation areas warning notice
- 15 Outdoor equipment socket outlet notice.

V80.3 PART 3 – EXECUTION

V80.3.1 PREPARATION

- A Seek approval for identification signs, labels, schematics prior to manufacture.
- A Verify identity of each item before installing identification products.
- B Complete the finish of the attachment surface before applying identification devices to it.
- C Clean equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

V80.3.2 INSTALLATION

- A Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B Fix labels and notices using materials compatible with label or notice and surface to which it is fixed by screws into tapped hole or bolted complete with washer nut and locking device.
- C Permanent signs must not be fixed with adhesive.
- D Attach signs and plastic labels with weather protected screws appropriate to the location and substrate.
- E Comply with the following for installation of services:
 - 1 Y60: For Conduits and trunking
 - 2 Y61: For cables
 - 3 Y63 for cable support
- F System Identification Colour-Coding Bands for Conduits and Cables: Each colour-coding band to completely encircle cable or conduit. Place adjacent bands of two-colour markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 15m maximum intervals in straight runs, and at 7.6m maximum intervals in congested areas.
- G Aluminium Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- H For underground ducts and buried services refer to section P30 of this specification

V80.3.3 EQUIPMENT IDENTIFICATION

- A Fit labels on all items of plant, equipment, switches, etc, include the following information:
 - 1 Plant reference, to correspond with reference used on drawings and in schedules
 - 2 Service controlled.
 - 3 Circuit reference (Where not included in plant reference).
 - 4 Voltage, type of supply and phase etc.
- B Equipment Identification Labels: Install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification:
 - 1 Labelling Instructions:
 - a Indoor Equipment: Unless otherwise indicated, provide a single line of text with 13-mm high letters on 38-mm high label; where two lines of text are required, use labels 50 mm high
 - b Outdoor Equipment: 100 mm high

- c Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor
 - d Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the IP rating of the enclosure.
- 2 Equipment to Be Labelled:
- a Panel-boards: Typewritten directory of circuits in the location provided by panel-board manufacturer. Panel-board identification shall be, engraved, laminated acrylic or melamine label
 - b Enclosures and electrical cabinets
 - c Access doors and panels for concealed electrical items
 - d Switchgear
 - e LV and MV Switchboards
 - f Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panel-boards or equipment supplied by the secondary
 - g Substations
 - h Emergency system boxes and enclosures
 - i Motor-control centres
 - j Enclosed switches
 - k Enclosed circuit breakers
 - l Enclosed controllers
 - m Variable-speed controllers
 - n Push-button stations
 - o Power transfer equipment
 - p Contactors
 - q Remote-controlled switches, dimmer modules, and control devices
 - r Battery-inverter units
 - s Battery racks
 - t Power-generating units
 - u Monitoring and control equipment
 - v UPS equipment
 - w Generators.

V80.3.4 MAINTENANCE NOTICES

- A Fix notices giving warning of, and instructions on, any special maintenance procedures to plant and equipment as indicated.

V80.3.5 MOTORS AND STARTERS LABELS

- A Fit identification labels to all motors, starters and starter panels.
- B Ensure positive identification of respective motors and starters.
- C Provide motors with non-corrodible labels attached adjacent to each bearing giving details of the lubricant to be used. Mark direction of normal rotation on motor casing.
- D Provide labels to identify motor equipment fitted with surge suppressors and thermistors stating that insulation test voltages must not be applied to thermistors and thermistor control units.
- E Ensure labelling is compatible with schematic and wiring diagrams, and complies with BS 4999, Part 108.

V80.3.6 SWITCHGEAR

- A Fit labels on switchgear as required by BS 7671 and BS EN 60439 to indicate duty of unit, its voltage, phase and current rating, protective device rating size of conductor involved, and all other necessary details.

- B Use an agreed serial coding system, provide at the switch a key to the coding system.

V80.3.7 DISTRIBUTION BOARDS

- A On each distribution board identify every outgoing way with a renewable circuit chart in a transparent plastic envelope permanently fitted inside distribution board cover.
- B Clearly indicate in typed script, circuit identification number cable size, fuse or circuit breaker rating, assumed design current and a description of item supplied and area supplied by circuit.

V81 EARTHING AND BONDING

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V81.1 PART 1 - GENERAL

V81.1.1 RELATED DOCUMENTS

- A For drawings and general provisions of the contract refer to main contract preliminaries and section A of this specification.
- B For performance details and physical sizes of plant and equipment refer to section D "Schedules of Equipment".
- C For system descriptions, operating pressures and temperatures refer to section B of this specification and the Schedules of Equipment.
- D Refer also to all other sections including the following:
 - 1 V30 "Low Voltage Distribution Systems"
 - 2 V31 "Low Voltage Switchgear"
 - 3 V80 "Electrical Identification"
 - 4 V85 "Electrical Testing and Inspection".
 - 5 Y41 Building Monitoring and Management
 - 6 Y50 Electrical Commissioning
 - 7 Y60 Conduit and Trunking
 - 8 Y61 LV and ELV Cables
 - 9 Y63 Cable Supports
 - 10 Y90 Fixing to Building

V81.1.2 SUMMARY

- A Supply Authority: Contact the supply Authority to establish earthing requirements.
- B HV Earthing: Where required shall comprise a separate substation earth bar and separate earthing array as required by the local utility company. The incoming utility cable earth shall be bonded to the HV substation earth bar in accordance with BS 7671.
- C LV Earthing: A separate LV earthing system and earthing array shall be provided in accordance with BS 7430 and BS 7671.
- D Where a combined MV and LV earthing system is proposed the earth electrode resistance including all parallel paths shall be 1 ohm or less in accordance with BS 7430 and BS 7671.
- E Section Includes: Earthing systems and equipment to provide a low impedance earth fault path to achieve automatic disconnection times, within specified limits and provide protection against indirect contact with exposed conductive parts of the installation.
- F Building Structure Used as Earthing system: Where the building structure is used as part of the earthing system this shall generally comprise reinforced piles, reinforced columns, reinforced slabs, walls and structural steelwork. These elements shall be bonded together to form a Faraday cage. The reinforcing may be utilized as the lightning protection system and general earthing system where local codes permit. (see earthing drawings for details).
- G Provide equipotential connections to all exposed metalwork and other conducting materials to ensure that no differences in potential exist. Provide a safe path to earth for any electrical current created by an electrical fault within or external to the premises and from interference from electromagnetic fields or electromagnetic forces.
- H Provide and take full responsibility for the earthing conductors from earth bars to equipment/studs on ductwork, pipework and all mechanical and electrical systems including, electrical continuity at joints of ductwork, pipework etc.

- I Where the building structure is used for earthing provide bonds at each HV and LV substation at the HV and LV earth bars.
- J Comply with local Electrical Supply company requirements.
- K All transformer enclosures shall be bonded to form a continuously earthed assembly and then bonded to the transformer bosses. Incoming HV, LV cables and Bus duct shall be bonded to the enclosure metal work.
- L At each substation Cast resin Transformer Neutrals shall be earthed within the main LV switchboard via removable links, the connection to the earth bar shall be via copper links of CSA not less than the earth bar, the neutral cable between the transformer star point and LV panel earth bar shall be single core LSF cable.
- M Generators: Where generators are specified at 11,000 Volt they shall be earthed via a neutral earthing resistor located as indicated on the drawings. The neutral earthing resistor shall be supplied by the generator supplier and will be rated as indicated on the HV drawings. The neutral earthing resistor shall be earthed at the substation and also via a separate earth electrode, the neutral earth cable installed between the neutral earthing resistor and earth electrode shall be single core LSF, the contractor shall allow for 10 No 2.5 metre copper clad steel driven earth rods spaced at 2.5 metres. Generator earthing shall comply with BS 7430 and BS 7671.
- N In general, all sub main cables shall be provided with a separate CPC clipped to the sub main cable, the CPC size shall be the same size as the Phase conductor.
- O The contractor shall supply and install Main equipotential bonds and supplementary bonds in accordance with BS 7671.
- P Section includes earthing systems and equipment, plus the following special applications:
- 1 Overhead-line earthing
 - 2 Underground distribution earthing
 - 3 Earth bonding common with lightning protection system.

V81.1.3 DEFINITIONS

- A Product Data: For each type of product indicated.
- B Informational Submittals: Plans showing dimensioned as-built locations of earthing features specified in "Field Quality Control" Article, including the following:
- 1 Test pits
 - 2 Earth rods
 - 3 Earth rings
 - 4 Earthing arrangements and connections for separately derived systems
 - 5 Earthing for sensitive electronic equipment
 - 6 Earth Bars
 - 7 Neutral Earthing resistors
 - 8 Transformer neutral earthing.
- C Qualification Data: For qualified testing agency and testing agency's field supervisor.
- D Field quality-control reports.
- E Operation and Maintenance Data: For earthing to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
- 1 Instructions for periodic testing and inspection of earthing features at test pits, earth rings, earthing connections for separately derived systems in accordance with BS 7430:
 - a Tests shall determine if earth-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not
 - b Include recommended testing intervals.

V81.1.4 PERFORMANCE REQUIREMENTS

- A For operating conditions and environment refer to section B of this specification.

V81.1.5 SUBMITTALS

- A Refer to Section A of this specification.
- B Product Data: For each type of product indicated.
- C Shop Drawings: For electricity-metering equipment:
- 1 Dimensioned plans and sections or elevation layouts
 - 2 Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and colour-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features
 - 3 Shop drawings shall include local utility requirements including meter wiring details, CT and VT arrangements.
- D Field quality-control reports.

V81.1.6 QUALITY ASSURANCE

- A Testing Agency Qualifications: Approved by local authorities having jurisdiction:
- 1 Testing Agency's Field Supervisor: Currently certified by local authorities to supervise on-site testing.
- B Ensure the construction, materials and finishes of all equipment are suitable for the location, climatic and operating conditions to which the installation shall be exposed.
- C Ensure that the whole installation complies with the relevant standards, including the following:
- 1 Local Utility company and wiring Regulations
 - 2 Local and national standards and codes of practice
 - 3 BS 1377 - Methods of test for soils for civil engineering purposes
 - 4 BS 6004 - Electric cables. PVC insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring
 - 5 BS 7430 - Code of practice for earthing
 - 6 BS 951 - Electrical earthing. Clamps for earthing and bonding
 - 7 BS EN 12163 - Copper and copper alloys. Rod for general purposes
 - 8 BS EN 13636 - Cathodic protection of buried metallic tanks and related pipework
 - 9 BS EN 15112 - External cathodic protection of well casing
 - 10 BS EN 50310 - Application of equipotential bonding and earthing in buildings with information technology equipment
 - 11 BS EN 61284 - Overhead lines. Requirements and tests for fittings
 - 12 BS EN 62305-3 - Protection against lightning. Physical damage to structures and life hazard
 - 13 TIA/EIA J-STD-607 - Commercial Building Earthing and Bonding Requirements for Telecommunications.
- D Use materials and installation methods in accordance with BS 7430 and Local Electricity Supply Authority Requirements as appropriate.

V81.1.7 CO-ORDINATION

- A Co-ordinate layout and installation of components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.

V81.2 PART 2 – PRODUCTS

V81.2.1 MAIN AND SUPPLEMENTARY EQUIPOTENTIAL BONDING

- A Bond in accordance with BS 7430 and BS 7671 to main earth terminal all extraneous conductive parts of the installation.
- B Ensure the following services are bonded:
- 1 Main water pipes
 - 2 Main gas pipes
 - 3 Fuel oil pipes
 - 4 Any other incoming metallic services including drainage pipe work
 - 5 Air duct-lines
 - 6 Heating pipe work
 - 7 Chilled water pipe work
 - 8 Exposed metallic parts of building structure
 - 9 Thermal insulation metallic cladding
 - 10 Metallic cable sheaths of all cables except Etisalat
 - 11 Lightning protection systems
 - 12 Electrical Containment
 - 13 HV and LV distribution equipment
 - 14 Generators
 - 15 All Mechanical equipment within plant rooms
 - 16 Metallic ceiling grids and raised access floors.
- C Bond with supplementary equipotential bonds to protective conductor system, all simultaneous accessible conductive parts.
- D Ensure the following areas are bonded to BS 7671 (Requirements for Electrical Installations):
- 1 Bathrooms and shower rooms
 - 2 Boiler houses
 - 3 Calorifier rooms
 - 4 All other plant rooms
 - 5 Wet and damp process areas
 - 6 Kitchens and laundries
 - 7 Building Façade (See structural Engineers drawings)
 - 8 Signage
 - 9 Display items within galleries
 - 10 Lift installations
 - 11 IT and multimedia equipment
 - 12 Security systems
 - 13 Marine areas including electrical bollards
 - 14 All equipment within workshops.
- E Bond to non-current carrying parts of Electrical Installation in associated spaces to BS 7671 and BS 7430.

V81.2.2 APPLICATIONS

- A Conductors: Install conductors in accordance with the cable schedules and comply with local codes for minimum cable sizes
- B Underground Earthing Conductors: Install bare tinned copper conductor and refer to cable schedules and drawings for details:
- 1 Bury at least 600 mm below grade

- C Isolated Earthing Conductors: Green-coloured insulation with continuous yellow stripe. On feeders with isolated earth, identify earthing conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D Earth Bars: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated:
 - 1 Install earth bar on insulated spacers 30 mm minimum from wall, 600 mm above finished floor unless otherwise indicated.
- E Conductor Terminations and Connections:
 - 1 Pipe and Equipment Earthing Conductor Terminations: Tinned copper ring type cable lugs, bolted
 - 2 Underground Connections: Welded connectors except in inspection housings and as otherwise indicated
 - 3 Connections to Earth Rods in inspection housings: Tinned copper ring type cable lugs, bolted
 - 4 Connections to Structural Steel: Welded connectors.

V81.2.3 CONDUCTORS

- A Insulated Conductors (Circuit Protective Conductors):
 - 1 Material - Insulated cable, single core to BS 7211 as indicated; armouring and/or metallic sheathing of armoured cables or integral conductor of multi-core cable
 - 2 Provide protective conductors sized in accordance with BS 7671.
- B Bare Copper Earthing Conductors:
 - 1 Use - Earthing conductor in accordance with BS 7430 and BS 7671
 - 2 Minimum dimension in accordance with BS 7430 and BS 7671
 - 3 Form - Strip
 - 4 Material - Copper, annealed
 - 5 Coverings – as required by installation
 - 6 Accessories - Conductor clips, metallic.
- C Main Earth Bar: Predrilled rectangular bars of hard drawn, tinned high conductivity copper bar, dimensions as indicated on drawings and schematics with holes sized as per earthing schematic and spaced 50mm apart. (Provide at least one for each cable +30% and minimum of two). Provide stand-off insulators for mounting to give 30mm clearance at rear. Comply with BS 7430 including testing.
- D Where bar dimensions are not indicated elsewhere comply with the following:
 - 1 Provide earth bar at incoming electrical service position adjacent to main LV switch panel
 - 2 Bond earth terminals and metallic structure of switch and control gear and plant
 - 3 Mount earth bar on insulated supports located at 300mm centres for 25mm bar and 450mm centres for 50mm bar, giving 30mm clearance at rear of bar
 - 4 Drill clearance holes, one for each cable plus 30% spare holes (two minimum) at 50mm minimum centres through bar for connection of cable lugs. Ensure clearance holes are minimum necessary size to maintain adequate lug/bar contact
 - 5 Provide 25mm bar earth matrix in each plant room for bonding of plant room services. Plant room earth bars to be connected to main switch room earth bar by 25mm² cable
 - 6 Connect each earth terminal to all other earth terminals by a ring conductor sized as BS 7430 and BS 7671.

V81.2.4 CONNECTORS

- A Listed and labelled by and acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected. Comply with BS 7430.

- B Earthing Clamps:
 - 1 Use clamps complying with BS 951, for bonding pipes and lead sheathed cables.
- C Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D Bus-bar Connectors: Mechanical type, cast silicon bronze, solder-less compression or exothermic-type wire terminals, and long-barrel, two-bolt connection to earth bus bar.
- E Copper Tape Joints:
 - 1 Provide waterproof protection at joints subject to moisture
 - 2 Joint copper tapes by brazing, using zinc-free brazing metal with melting point at least 600°C or thermic welding.
- F Stranded Conductor Joints:
 - 1 Provide waterproof protection at joints subject to moisture
 - 2 Joint copper stranded conductors with compression joints to BS EN 61284.
- G Provide lugs or tags to enable connection of bonding conductors to equipment earth terminals.
- H Dissimilar metals: Ensure, where dissimilar metals are used for system, that purpose made jointing materials is used such that corrosion and deterioration of the electrical connection are not caused. Ensure bonding connections to other metal parts of building are electrolytically compatible with those metal parts. Use the guidance given in BS 7430 Table 8 when bonding dissimilar materials.
- I Clean Earth Distribution: Comply with BS EN 50310: "Application of equipotential bonding and earthing in buildings with information technology equipment" and TIA standard 568 Where clean earth distribution is required provide a separate earthing system from the clean earth busbar either integral to or adjacent to clean earth distribution boards. Mount all bus bars with insulators and separate from other earthing systems.

V81.2.5 MAIN EARTH TERMINAL CONNECTIONS

- A Connect main earth conductors and main equipotential bonding conductors to main earth terminals.
- B Terminate circuit protective conductors on switchboard earthing bar. Terminate conductors with compression type lugs suitable for bolting direct to bar.
- C Extend protective conductor from incoming main cable gland direct to main earth terminal.
- D Extend separate protective conductor from main earth terminal to main switch/switch panel served by incoming main cable.
- E When main cable is provided by electrical supply company, extend separate protective conductor from main cable armouring gland or direct earth terminals or PME earth installed by supply company to main earth terminal.
- F Bond all main equipment and plant to an earth terminal, connected to the bonding ring conductor.

V81.2.6 SUBSTATION MAIN EARTH BUSBAR TERMINATIONS

- A Provide terminations on busbar for each Substation main earth conductor.
- B Provide the following additional terminations on busbar for each substation main earth conductor as detailed in this specification:
 - 1 HV Switchgear frame earth (bare copper tape)
 - 2 LV Switchgear frame earth (bare copper tape)
 - 3 Transformer frame earths (bare copper tape)

- 4 Transformer neutral earths (insulated copper cable)
- 5 LV Switchboard neutral busbars (insulated copper cable)
- 6 Earthing conductor to minimum 2 groups of electrodes
- 7 Allow for 30% future cable/tape terminations.

V81.2.7 PROTECTIVE CABLE TERMINATIONS

- A For bolted connections use crimp type lugs compressed by automatic tool to achieve correct pressure and crimp depth.
- B Make connections between tape and equipment using high tensile grade brass bolts with brass nuts, washers and locking devices. Use phosphor bronze bolts, nuts and washers where connections are liable to corrosion.

V81.2.8 FRAME EARTH LEAKAGE

- A Where frame earth leakage devices are used for phase to earth protection, connect two earthing conductors as BS 7430, one to the framework of the switchgear and main earth bar via current transformer or other devices, the other to cable sheaths and earthing devices, insulated where necessary.

V81.2.9 SYSTEM EARTHING ELECTRODES

Copper-clad steel earth rods are the most common earthing electrode. See Evaluations for discussion on alternative materials. Sectional rods are used when electrodes longer than 3 m are required.

- A Earth Rods: Copper minimum size as BS 7430 Table 4:
 - 1 Form - rod with female thread each end
 - 2 Dimensions:
 - a Rod Diameter - 15mm - nominal
 - b Rod Length - 2.4m (2 × 1.2) minimum.
- B Earth electrode couplings:
 - 1 Use high strength driving cap in contact with driven rod and couplings of compatible material fully enclosing the rod threads
 - 2 Interconnect electrodes using bare copper tape 25mm × 6mm.
- C Provide concrete cover, permanently labelled, for electrodes installed through cable draw-pit bases.
- D Connect main earth conductor to first electrode using heavy duty purpose made silicon aluminium bronze body conductor clamp and high tensile phosphor bronze bolt:
 - 1 Material, minimum size as BS 7430 Table 4 - Copper
 - 2 Accessories: Rod to tape clamp. Sized to suit earth rod and connector.

V81.2.10 NEUTRAL / EARTH CONNECTION

- A Provide earth leakage protection system and position neutral / earth connection

V81.2.11 BUILDING OR STRUCTURAL ELEMENT EARTH ELECTRODES

- A Standard BS EN 62305-3.
- B Form - Building or structural element.
- C Earth electrode couplings:

- 1 Use silicon bronze alloy or aluminium bronze alloy, counter bored to completely enclose rod threads. Ensure rods meet in centres of coupling
 - 2 Use high strength driving cap in contact with driven rod and couplings of compatible material fully enclosing the rod threads.
- D Interconnect electrodes using 25 × 3mm bare copper tape.
- E Provide concrete cover, permanently labelled, for electrodes installed through cable draw-pit bases.
- F Material, minimum size as BS EN 62305-3, BS 7430 Table 4 - Molecularly bonded copper clad steel rods to BS 7430.
- G Accessories: Rod to tape clamp or U-bolt clamp. Accessories sized to suit earth rod and connector.

V81.2.12 EARTH ELECTRODES FOR CATHODICALLY PROTECTED STRUCTURES

- A Provide earth electrode for cathodic protection system in accordance with BS 7430 and Cathodic protection codes: BS EN 15112 and BS EN 13636.

V81.2.13 EARTH ELECTRODE CLAMPS

- A Connect tape to electrode head using heavy duty purpose made silicon aluminium bronze body connector clamps or leaded gunmetal body connector clamps, and high tensile phosphor bronze bolts to BS EN 12163.

V81.2.14 EARTH ELECTRODE INSPECTION FACILITIES

- A Provide enclosure for each connection between earth conductor and associated earth electrode system. Install so that top is flush with finished ground or floor level. Ensure enclosure provides adequate access for testing purposes. Provide pit details for builderswork.
- B Labelling - Wording, Earth.

V81.2.15 EARTH ELECTRODE TANK PENETRATION SEAL – (WHERE REQUIRED)

- A Dimensions:
- 1 Screed depth (mm) 54 minimum
 - 2 Slab depth (mm) 158 maximum
 - 3 Flange area (m²) 0.125 minimum.
- B Form - Earth rod to tube seal by compression ring and seal.
- C Slab former - Standard earth rod pit.

V81.2.16 EQUIPOTENTIAL BONDS

- A Main (Building Elements):
- 1 Provide main equipotential bonds in accordance with BS 7430 and BS 7671
 - 2 Material - Insulated cable, single core to BS 6004
 - 3 Use no joints in main equipotential bonds.
- B Supplementary (Extraneous metalwork):
- 1 Provide supplementary equipotential bonds to BS 7430 and BS 7671. Joints not allowed in these bonds
 - 2 Material - Insulated cable, single core to BS 6004.

V81.2.17 PORTABLE EARTH CONNECTIONS

- A Provide tape loops for the connection of portable earths.

V81.2.18 CEILING SUPPORTS

- A Bond main supports to non-current metallic parts of Electrical Installation. Use LSF insulated copper cable, of minimum cross-sectional area of 4mm².
- B Use holes in main supports for terminal screws. Connect bonding conductors to supports through holes with tinned copper cable lugs or tags secured to support with brass screws, washers, nuts and locking device.

V81.2.19 SAFETY EARTHING

- A Provide safety earthing in accordance with BS 7430, BS 6423 and BS 6626.

V81.2.20 RISE IN POTENTIAL IN TELECOMMUNICATIONS CIRCUITS

- A Ensure the potential rise in telecommunications circuits due to power system earth faults is limited, as BS 6701.

V81.2.21 HIGH VOLTAGE SYSTEM EARTHING

- A Install MV systems earthing to BS 7430. Connect all exposed conductive parts of the system to earth via protective conductors. Provide earth fault relay to detect currents of 10% - 15% of full load current.
- B Provide an earth loop impedance path by earthing and bonding to achieve operation of the earth fault relay at this current. Ensure extraneous conductive parts of the system are in direct contact with all simultaneous accessible conductive parts, if necessary, by bonding or connection to the common steelwork structure. Connect the neutral of the MV system to one point only. Use the generator or supply transformer star point.
- C Earth neutral as indicated on the drawings.
- D Where a resistor or reactor is used, use the resistor or reactor to limit fault current to not more than 1.5 times the full load current of the largest unit in the system. Ensure if direct earthing is used the earth fault current is of the order necessary to operate the protective devices and does not produce unacceptable electromagnetic stresses. For delta connected sources use an earthing transformer between the phases and earth. For multiple power sources use switchgear to ensure single point earthing under all operating conditions.

V81.2.22 EARTHING OF MARINA ELECTRICAL SYSTEMS

- A Install earthing of marina electrical systems to BS 7430 and BS 7671. Ensure all conductors subject to tidal and wave movement are arranged and of materials to avoid the deleterious effects of that movement. Do not extend a pme or TN-C-S system to a boat supply socket outlet. Do not use any aluminium or mineral insulated metallic clad cables as protective conductors. Use no joints in protective conductors except at properly protected enclosures. Bond all metalwork on pontoons or landings which may come into contact with the electrical system to the system protective conductor. Provide fuelling point bonding conductors and connection to the system protective conductor so that boats maybe bonded before a fuel connection is made and disconnected after the fuel connection is broken.

V81.2.23 EARTHING OF ELECTRICALLY SUPPLIED STREET FURNITURE

- A Install earthing to street furniture in accordance with BS 7430 and BS 7671.

- B TN-S systems. Use cable with separate phase neutral and protective conductors to supply street furniture. Ensure on the load side of the protective device separate phase, neutral and protective conductors are used. Bond conductive parts of the street furniture to the earthing terminal within the equipment. Connect the supply protective conductor to the same earthing terminal.
- C TN-C-S systems. Use a combined neutral and earth (CNE) cable to supply street furniture. Use separate conductors for phase, neutral and protection on the load side of the protective device. Bond exposed conductive parts of the street furniture using a 10mm², or the size of the neutral if smaller, cable. Do not bond small items not likely to come into contact with exposed or extraneous conductive parts or earth. On circuits feeding more than one item of street furniture, provide an earth electrode of 20 ohm or less resistance at the last or pen-ultimate item of furniture on the circuit. Where an electrode resistance of 20ohm cannot be achieved, provide earth electrodes at each item of furniture.
- D TN-C where the supplier's earth terminal is not used or TT systems. Install a protective earth electrode system at the source of supply. Use cable with separate phase neutral and protective conductors to supply the street furniture, with the protective conductor connected to the earth electrode. Ensure on the load side of the protective device separate phase, neutral and protective are used. Bond conductive parts of the street furniture to the earthing terminal within the equipment. Connect the supply protective conductor to the same earthing terminal.

V81.2.24 EARTHING OF ELECTRICAL SYSTEMS IN HAZARDOUS AREAS

- A Install earthing of electrical systems in hazardous areas to BS 7430 and BS EN 60079. Use the recommendations in HS (G)41 at petrol filling stations.

V81.2.25 OVERHEAD LINE EARTHING

- A Earth overhead line plant in accordance with BS 7430 and the electricity supply regulations. Do not earth or bond insulator steelwork unless so directed.

V81.2.26 EARTH FAULT RELAYS

- A Provide earth faults relays as detailed on the schematic drawings and in the electrical specification.

V81.2.27 HIGH VOLTAGE CABLE SHEATHS AND ARMOUR

- A Bond the sheaths and armour of medium voltage cables solidly to earth. For 3 core cables bond at both ends. For single core tails bond cables at both ends of tail.

V81.2.28 LOW VOLTAGE SHEATHS AND ARMOUR

- A Bond the sheaths and armour of low voltage cables solidly to earth:
 - 1 Multi core cables, at both ends
 - 2 Single core cables at supply end only.

V81.2.29 METALLIC FENCING

- A Bond to earth any metallic fencing enclosing earth electrical system in accordance with BS 7430.

V81.2.30 TRANSFORMER OR GENERATOR EARTH ELECTRODE SYSTEMS

- A Provide separate electrode systems, each not exceeding 1 ohm resistance, with separate main earthing conductors for each transformer, each switchboard listed in the schedules and an additional spare electrode

system for test purposes. Bond all electrode systems together using a ring conductor. Connect electrode systems to ring conductor via links or disconnecting joints for test purposes.

- B Provide separate electrode systems, each not exceeding 2 ohms resistance, with separate main earthing conductors for each generator, and an additional spare electrode system for test purposes. Bond all electrode systems together using a ring conductor. Connect electrode systems to ring conductor via links or disconnecting joints for test purposes.
- C Earth electrodes to be 16mm copper/steel core bonded earth rods with driving pin and head, driven to a minimum depth of 3 metres. The earth electrode shall be installed inside a 300x300x300mm earth pit with inspection cover. The connection to the earth electrode within the inspection pit shall be made by a corrosion resistant terminal clamp and covered with denso-tape. Parallel rods shall be spaced a distance apart equal to twice their driven depth.

V81.2.31 EARTHING OF MOBILE GENERATORS

- A Bond the generator frame, all exposed metalwork, underframe or chassis and all protective conductors, to BS 7430, to form common reference point. Connect generator star point to this common reference. Provide a separate connection from this reference to the load by a fifth cable core or separate single cable.

V81.2.32 EARTHING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A Comply with BS 7430 and local Utility wiring regulations.
- B Earthing Manholes and Hand holes: Install a driven earth rod through manhole or hand hole floor, close to wall, and set rod depth so 100 mm will extend above finished floor. If necessary, install earth rod before manhole is placed and provide suitably sized bare, tinned-copper conductor from earth rod into manhole through a waterproof sleeve in manhole wall. Protect earth rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 50 mm above to 150 mm below concrete. Seal floor opening with waterproof, non-shrink grout.
- C Earthing Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or hand hole, to earth rod or earthing conductor. Make connections with suitably sized stranded, hard-drawn copper bonding conductor. Train conductors' level or plumb around corners and fasten to manhole walls. Connect to cable armour and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D Where Pad mounted Transformers and switches are to be provided by the Utility: Install two earth rods and earth ring around the pad. Earth pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and earthing electrodes. Install tinned-copper conductor tape less than 25mm x 3mm for earth ring and for taps to equipment earthing terminals. Bury earth ring not less than 50mm from the foundation.

V81.2.33 EQUIPMENT EARTHING

- A Install separate insulated equipment earthing conductors with all feeders, branch circuits and final circuits.
- B Water Heater, Heat-Tracing, and Anti-frost Heating Cables: Install a separate insulated equipment earthing conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- C Isolated Earthing Receptacle Circuits: Install an insulated equipment earthing conductor connected to the receptacle earthing terminal. Isolate conductor from raceway and from panel board earthing terminals. Terminate at equipment earthing conductor terminal of the applicable derived system or service unless otherwise indicated.
- D Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a non-metallic raceway fitting listed for the

purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment earthing conductor. Isolate conductor from raceway and from panel board earthing terminals. Terminate at equipment earthing conductor terminal of the applicable derived system or service unless otherwise indicated.

E Signal and Communication Equipment: In addition to earthing and bonding required by BS 7671 provide a separate earthing system complying with requirements in TIA/ATIS J-STD-607-A:

- 1 For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG/25mm minimum insulated earthing conductor in raceway from earth electrode system to each service location, terminal cabinet, wiring closet, and central equipment location
- 2 Service and Central Equipment Locations and Wiring Closets: Terminate earthing conductor on a 6.3-by-100-by-300-mm earth bar
- 3 Terminal Cabinets: Terminate earthing conductor on cabinet earthing terminal.

F Metal Poles Supporting Outdoor Lighting Fixtures: Install earth electrode and a separate insulated equipment earthing conductor in addition to earthing conductor installed with branch-circuit conductors.

V81.3 PART 3 – EXECUTION

V81.3.1 INSTALLATION

- A Carry out installation of earthing system in accordance with BS 7430 and BS 7671.
- B Carry out soil tests in accordance with BS 1377 to establish soil electrical resistivity.
- C Existing Installations: Check earth continuity conductors and loop impedance values of existing installation. Report defects and elements not in accordance with BS 7671 before connecting new or modified installations to existing supply.
- D Examine the areas and conditions under which the earthing is to be installed and correct any unsatisfactory condition, detrimental to the proper and timely completion of work, or advise the CA of any such detriment if not a responsibility under this specification. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the CA.
- E Earthing Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- F Earth Bonding Common with Lightning Protection System: Comply with BS 7671 when interconnecting with lightning protection system. Bond electrical power system earth directly to lightning protection system earthing conductor at closest point to electrical service earthing electrode. Use bonding conductor sized same as system earthing electrode conductor, and install in conduit, unless indicated on detailed lightning protection drawings.
- G Earth Rods: Drive rods until tops are 50 mm below finished floor or final grade unless otherwise indicated:
 - 1 Interconnect earth rods with earthing electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any
 - 2 For earthing electrode system, install earthing electrode system in accordance with BS 7430.
- H Test Wells: Earth rod driven through drilled hole in bottom of hand hole. Hand holes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 300 mm deep, with cover:
 - 1 Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the earth rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- I Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit:
 - 1 Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts
 - 2 Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment
 - 3 Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- J Earthing and Bonding for Piping:
 - 1 Metal Water Service Pipe: Install insulated copper earthing conductors, in conduit, from building's main service equipment, or earth-bar, to main metal water service entrances to building. Connect earthing conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect earthing conductor on street side of fitting. Bond metal earthing conductor conduit or sleeve to conductor at each end
 - 2 Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector

- 3 Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- K Bonding Interior Metal Ducts: Bond metal air ducts to equipment earthing conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- L Earthing for Steel Building Structure: Install a driven earth rod at base of each corner column and at intermediate exterior columns at distances not more than 18m apart, Refer to drawings for details of earthing steel structure.
- M Where earth rings are required Install a earthing conductor, electrically connected to each building structure earth rod and to each steel column indicated extending around the perimeter of the building:
- 1 Install tinned-copper conductor not less than 70mm for earth ring and for taps to building steel
 - 2 Bury earth ring not less than 600 mm from building's foundation.
- N Where Concrete-Encased Earthing Electrode are specified: Fabricate according to BS 7430; use a minimum of 6 m of bare copper conductor not smaller than 25MM:
- 1 If concrete foundation is less than 6 m long, coil excess conductor within base of foundation
 - 2 Bond earthing conductor to reinforcing steel in at least four locations and to anchor bolts. Extend earthing conductor below grade and connect to building's earth grid or to earthing electrode external to concrete.

V81.3.2 EARTHING OF LARGE MOBILE OR TRANSPORTABLE PLANT

- A Earth the source via a liquid resistor to limit the rise in potential of the plant to 50V under earth fault conditions. Use screen and armour of trailing and fixed cables as earth path from plant to source. Ensure all cabling and switchgear is suitable for impedance-earthed systems.

V81.3.3 EARTHING OF CONSTRUCTION SITE ELECTRICAL SYSTEMS

- A Earth construction site electrical systems to BS 7430, BS 4363 and BS 7375.

V81.3.4 QUALITY CONTROL

- A Handle, store and install all equipment and components of the earthing system in accordance with the manufacturer's recommendations and BS 7430.
- B Inspect all equipment and components on delivery, before fixing and after installation and reject and replace any which are defective.
- C Test and commission the system in accordance with BS 7430 and BS 7671 and as specified. Record all test measurements.

V81.3.5 IDENTIFICATION

- A Use numbered and/or lettered plastic cable sleeves to indicate circuit numbers and phases of corresponding phase conductors.
- B Ensure conductors are connected to earth bar in same sequence as phase and neutral conductors.
- C Identify at substation, switchboard and building earth bars each protective, bonding and earthing conductor. Provide labels on bars adjacent to each conductor.

V81.3.6 EXCHANGE OF INFORMATION

- A Consult with the local Electrical Supply Company regarding the earthing arrangements of the installation. Construct the earthing system to the requirements of local electrical supply company. Ensure any part of

the earth fault current path provided by local supply company is suitable for the operation of the earth fault protection to be installed. Obtain the agreement and permission of undertakings providing services, which are to be bonded to the earthing system.

V81.3.7 LABELLING & WARNING NOTICES

- A Protective Conductors: Provide a permanent engraved laminated label durably marked in letters 4.75mm minimum height "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE" in visible position, at each bonding conductor connection to extraneous conductive parts.
- B Main Earth Conductor - Warning Tapes: Provide green / yellow PVC tapes with engraved laminated labelled "EARTHING CONDUCTOR" over complete external lengths of main earth conductors at 300mm depth below finished ground.
- C Earth Bar Label: Label earth bar "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE" with wall mounted engraved laminated plastic tablet engraved in 10mm high red letters on white background.
- D Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.
- E Install labels at the telecommunications bonding conductor and earthing bus bar and at the earthing electrode conductor where exposed]:
 - 1 Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

V81.3.8 TEST LINKS

- A Provide two test links, in connections between main earth conductors and earth bus bar. Fabricate each from two additional sections of earth busbar. Mount one section on stand-off insulators matching earth busbar; use remaining section as removable test link. Secure 12mm high tensile brass studs to fixed sections of bus bar and drill corresponding clearance holes in test links and provide brass washers, nuts and locking devices to secure frame/neutral earthing and test links.

V81.3.9 FIELD QUALITY CONTROL

- A Testing Agency: Engage a qualified testing agency to perform tests and inspections:
 - 1 Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B Tests and Inspections:
 - 1 After installing earthing system but before permanent electrical circuits have been energized, test for compliance with requirements
 - 2 Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions
 - 3 Test completed earthing system at each location where a maximum earth-resistance level is specified, at service disconnect enclosure earthing terminal at earth test wells and at individual earth rods. Make tests at earth rods before any conductors are connected:
 - a Measure earth resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural earth resistance
 - b Perform tests by fall-of-potential method according to BS 7430.
 - 4 Prepare dimensioned Drawings locating each test well, earth rod and earth-rod assembly, and other earthing electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include

observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

- C Earthing system will be considered defective if it does not pass tests and inspections.
- D Prepare test and inspection reports.
- E Report measured earth resistances that exceed the values indicated in BS 7430 and BS 7671.
- F Excessive Earth Resistance: If resistance to earth exceeds specified values, notify Architect promptly and include recommendations to reduce earth resistance.

W31 DATA DISTRIBUTION SYSTEMS

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W31.1 PART 1 – GENERAL

W31.1.1 RELATED DOCUMENTS

- A For drawings and general provisions of the contract refer to main contract preliminaries and section A of this specification.
- B For performance details and physical sizes of plant and equipment refer to section D "Schedules of Equipment".
- C For system descriptions, operating pressures and temperatures refer to section B of this specification and the Schedules of Equipment.
- D Refer also to the following sections:
 - 1 V30 "Low Voltage Distribution Systems"
 - 2 V31 "Low Voltage Switchgear"
 - 3 V81 "Earthing and Bonding Systems"
 - 4 V85 "Electrical Testing and Inspection"
 - 5 Y41 Building Monitoring and Management
 - 6 Y50 Electrical Commissioning
 - 7 Y60 Conduit and Trunking
 - 8 Y61 LV and ELV Cables
 - 9 Y63 Cable Supports
 - 10 Y90 Fixing to Building

W31.1.2 SUMMARY

- A This specification provides the minimum performance criteria for the components and sub-systems comprising a complete data transmission system.
- B The project is defined as the supply, installation, development of the design, termination and testing of cabling infrastructure to support data communications, in accordance with this specification and the project schematics and plans. This shall include but not be limited to all structured wiring, fibre cable optical converters, patch panels, terminal blocks, patch leads, faceplates, cable management, racks, over-voltage protectors and splice housings.
- C The specification includes provision of design finalisation, of cabling and installations. All cables shall be enclosed in cable ducts, mounted on cable basket and trays or J Hooks as indicated on the drawings.
- D Product specifications, general design considerations, and installation guidelines are provided in this written document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types for a specific facility will be provided in this specification or on the drawings. Meet or exceed all requirements for the cable system described in this document.
- E Be fully responsible for the finalisation of the design and any development of the design of all data transmission systems.
- F Provide all necessary components to form a complete voice / data installation as indicated within this specification and on the drawings provided.
- G The components for individual channels will be from the same manufacturer and will be backed by an applications assurance warranty.

W31.1.3 PERFORMANCE REQUIREMENTS

- A Delegated Design: Design supports and seismic restraints for control consoles, equipment cabinets and racks, and components, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- B The Data specialist shall carry out the detailed design of the Data distribution system. This specification and associated drawings and documents do not list every item of equipment or material needed but are indicative of design intent. Data Distribution specialist shall be responsible for providing a complete detailed design and ensuring that the equipment has the required connectivity, functionality and performance.
- C The detailed design shall include all appropriate accessories, brackets, fixings, connectors, loose cables, interface cards, relays, terminals, routers, power supplies, battery provision, standard and custom software and all other items required to satisfy the design intent unless specifically excluded.

W31.1.4 SUBMITTALS

- A Provide all documentation necessary to facilitate installation and permit the owner to properly maintain and use the systems. These documents shall be submitted to the owner for approval prior to manufacture of installation of any system components, and shall include the following:
 - 1 Schedule of contract documentation
 - 2 Qualification Data: For qualified Installer and testing agency.
 - 3 Description of operation of the system
 - 4 Schedule of equipment including minor parts and accessories following detailed design
 - 5 Wiring diagrams or wiring schedules for all installed equipment. Complete wiring details including connector pin-outs and wiring colour codes should be included
 - 6 Schedule of site cables, including segregation requirements
 - 7 Termination details for installed cables at equipment racks and field equipment
 - 8 Equipment rack elevations and manufacturing details
 - 9 Equipment layout drawings showing the physical location of all equipment
 - 10 Schedule of any associated building work required, including any integration details required by other trades
 - 11 Field equipment installation detail drawings. These should include equipment weights, fixing methods and description of any secondary fixings required
 - 12 Electrical power supply requirements. Coordinate with the electrical contractor to ensure that power supplies are installed as appropriate
 - 13 Equipment thermal outputs. The Data Distribution specialist shall coordinate with the HVAC contractor to ensure that suitable ventilation and cooling is provided.
 - 14 Calculations and calculation methods for sizing and selection of equipment
 - 15 Schedule of equipment and cable labelling with explanation of numbering systems
- B Field quality-control reports.
- C Operation and Maintenance Data: For data distribution systems to include in operation, and maintenance manuals.

W31.1.5 QUALITY ASSURANCE

- A Ensure that the design, construction, materials and finishes of all equipment are suitable for the location, climatic and operating conditions to which the installation will be exposed.
- B The cabling system described in this document is derived from the recommendations made in recognised telecommunications industry standards. The documents listed below should be used as reference.
- C Common standards:
 - 1 BS EN 50174-1+A1 - Information Technology-Cabling Installation. Specification and quality assurance
 - 2 BS EN 50174-2+A1 - Information Technology- Cabling Installation. Installation planning and practices inside buildings
 - 3 BS EN 50174-3 - Information Technology- Cabling Installation. Installation planning and practices outside buildings

- 4 ISO/IEC 11801(CONS-2-1) - Information technology - Generic cabling for customer premises
- 5 ISO/IEC 14763-1ED 1 - Information technology - Implementation and operation of customer premises cabling – Administration
- 6 ISO/IEC 14763-2ED 1 - Information technology - Implementation and operation of customer premises cabling - Planning and installation of copper cabling
- 7 ISO/IEC 18010Ed 1 - Information Technology – Pathways and spaces for customer premises cabling
- 8 TIA/EIA-568-C - Commercial Building Telecommunications Cabling Standard
- 9 TIA/EIA-569-C-1 - Commercial Building Standard for Telecommunications Pathways and Spaces.
- 10 TIA/EIA -570-C - Residential Telecommunications Cabling Standard
- 11 TIA/EIA-606-B - Administration Standard for the Telecommunication Infrastructure of Commercial Buildings
- 12 TIA-758-B - Customer Owned Outside Plant Telecommunications Infrastructure Standard
- 13 BICSI-Telecommunications Distribution Methods Manual
- 14 BS 6701 - Telecommunications equipment and telecommunications cabling. Specification for installation, operation and maintenance
- 15 EN 50310 - Application of equipotential bonding and earthing in buildings with information technology equipment.

D EIA/TIA Category 6 or ISO/IEC Class E:

- 1 CENELEC EN 50173 - Information technology. Generic cabling systems
- 2 ISO/IEC 11801(CONS-2-1) - Information technology. Generic cabling for customer premises
- 3 ANSI/TIA-568-C.2 - Commercial Building Telecommunications Cabling Standard – Part 2: Balanced Twisted Pair Cabling Components.

E Fibre Optic:

- 1 BS EN 60794-1-23, BS EN 60794-1-22 and BS EN 60794-1-1
- 2 ANSI/TIA/EIA-568-B.3 - Optical Fibre Cabling Components Standard.

F If this document or any of the documents listed are in conflict, then the more stringent shall apply. All documents listed are believed to be the most current releases of the documents. Be responsible for determining and adhere to the most recent release when developing the proposal for installation.

W31.2 PART 2 – PRODUCTS

W31.2.1 REGISTERED COMMUNICATION DISTRIBUTION DESIGNER (RCDD)

- A In order to respond to this document, it is imperative that a company has at least one RCDD on staff, who can demonstrate expertise in design, integration and implementation of telecommunications (voice, data, video, audio and other low voltage control) transport systems and their related infrastructure components.

W31.2.2 DEFINITION OF TERMS USED IN THIS DOCUMENT

- A Definitions are as follows:
- 1 LDF - Local Distribution Frame
 - 2 MDF - Main Distribution Frame
 - 3 IDC - Insulation Displacement Connection
 - 4 TO - Telecommunications Outlet.

W31.2.3 TRANSMISSION

- A It is a mandatory requirement that the proposed structured cabling solution supports the following transmission requirements:
- 1 Category 5E/Class D or Category 6/Class E standards as defined by ANSI/TIA-568-C.2, ISO 11801 or EN 50174 and EN 50173
 - 2 IEEE 802.3 Ethernet (10BaseT) and Fast Ethernet (100BaseT)
 - 3 EIA RS 232-D (asynchronous)
 - 4 100 Mbit/s services - i.e. TPDDI/CDDI/TP-PMD
 - 5 ATM standards (including 25Mbit/s, 155Mbit/s and 622Mbit/s)
 - 6 1000 Mbit/s services - i.e. Gigabit Ethernet
 - 7 Analogue and Digital Voice Telephony.

W31.2.4 CABLE SEGREGATION

- A Notwithstanding the compliance to BS 6701 and the issues of cable segregation, take additional care to ensure cables are not routed adjacent to other services where electro-magnetic emissions may be being generated. Confirm the minimum segregation distances from other services as specified by the cable manufacturer.

W31.2.5 ELECTRO-MAGNETIC COMPATIBILITY

- A Confirm that all of the cabling components proposed have been successfully tested for EMC compliance as specified in the European Union Directive 2004/108/EC.
- B Confirm whether compliance is based on manufacturing to a harmonised European standard or preparation of a technical construction file.

W31.2.6 PRODUCT SPECIFICATIONS

- A Category 5e / Class D Cable - Horizontal cabling shall be 24 AWG, 4-pair UTP, UL rated, with a PVC or LS0H jacket. Cable shall meet the performance requirements listed in the following table in addition to all other standard Category 5e /Class D performance requirements.
- B Category 6 / Class E Cable - Horizontal cabling shall be 23 AWG, 4-pair UTP, UL rated, with a PVC or LS0H jacket. Cable shall meet the performance requirements listed in the following table in addition to all other standard Category 6 / Class E performance requirements.

- C Category 3 / Class C Cable – Vertical or backbone cabling shall be 24 AWG, 4-pair UTP, UL rated, with a PVC or LS0H jacket. Cable shall meet the performance requirements listed in the following table in addition to all other standard Category 3 / Class C performance requirements.
- D Cable shall be supplied on wooden reels or reel-in-box to eliminate kinks. Cable performance shall be third-party verified by an internationally recognised independent testing laboratory.

W31.2.7 OUTLET FACEPLATES

- A Each faceplate shall contain two eight position modular jacks. Faceplates shall each accommodate two labels and provide a clear polycarbonate cover to protect each label. Outlets performance shall be third-party verified by an internationally recognised independent testing laboratory.
- B All outlets shall be installed in the following manner:
 - 1 Cables shall be coiled in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. No more than 300mm of UTP shall be stored in an in-wall box, modular furniture raceway, or installed walls. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable
 - 2 Cables shall be dressed and terminated in accordance with the recommendations made in the relevant system standard document, manufacturer's recommendations and the best industry practices
 - 3 Pair untwist at the termination shall not exceed 12mm (one-half inch)
 - 4 Bend radius of the cable in the termination area shall not be less than 4 times the outside diameter of the cable
 - 5 The cable jacket shall be stripped back as much as is required
 - 6 Voice jacks in horizontally oriented faceplates shall occupy the right-most position(s). Voice jacks, unless otherwise noted in drawings, shall be located in the bottom position(s) of each faceplate in vertically oriented faceplates
 - 7 Data jacks in horizontally oriented faceplates shall occupy the left-most position(s). Data jacks shall occupy the top position(s) in vertically oriented faceplates
 - 8 For tender purposes, all back-boxes for outlets to be of 45mm deep type.

W31.2.8 FACEPLATES

- A In addition to the performance specifications, the faceplate shall also meet the following requirements:
 - 1 All outlets shall be provided with spring loaded shutters in that automatically close when patch leads are removed
 - 2 All IDC connector blocks shall be permanently fixed to the faceplate
 - 3 All unused faceplate apertures shall be provided with blanking plates
 - 4 The finish of the faceplate shall exactly match adjacent electrical accessories
 - 5 Samples of face plates and all visible elements shall be approved by the architect prior to installation.

W31.2.9 CABINET SPECIFICATIONS

- A When pricing for equipment cabinets, include for delivery, full assembly, location, baying kits and baying of cabinets (where more than one cabinet is co-located), removal of wheels, support on a rigid plinth or false floor, connection of all power strips to an adjacent isolator switch, powering up and testing of all electrical items.
- B All cables shall enter the cabinets via bottom of the cabinet.
- C A UPS unit is to be fitted at the base of the cabinet rack connecting one power bar-strip to the UPS output with the UPS input connected to an adjacent isolator switch.
- D Cabinet racks must comprise:

- 1 Transparent front and rear lockable doors
- 2 All door locks to be lockable with a common key (Type 92250)
- 3 Bottom grommeted cable entries
- 4 A means of being secured to floor, ceiling or overhead racking as appropriate
- 5 Front and rear adjustable rails for equipment, providing standard 19" rack mounting. (The front rails must be recessed by 100mm)
- 6 Cable management in the front of the cabinet for routing of patch cords both horizontally and vertically. As a minimum, a 1U horizontal cable management bar and two vertical cable rings should be supplied per 2U of termination or applications presentation
- 7 Vertical 100mm plasticised cable tray installed in each side of the rear of the cabinet
- 8 8 outlet power strips on both sides of the rear of the cabinet, providing a minimum of sixteen 13-amp power outlets
- 9 A four-way fan tray to be located within the roof of the equipment cabinet
- 10 A rack mounted 1 kVA UPS capable of providing standby power to the active equipment in each CWC for at least 10 minutes at full load
- 11 Cabinets shall be earthed
- 12 Each cabinet shall be provided with a documentation wallet to be located inside the cabinet, in an accessible location
- 13 Each equipment cabinet shall be provided with a 1U blanking plate to be located at the top of the cabinet and engraved with an identification code to be confirmed.

W31.2.10 OPEN FRAME RACK

- A When pricing for open frame racks, include for delivery, full assembly, location, buying kits and buying of cabinets (where more than one rack is co-located), connection of all power strips to an adjacent isolator switch, powering up and testing of all electrical items.
- B All cables shall enter the cabinets via the top of the rack.
- C A UPS unit is to be fitted at the base of the rack connecting one power bar-strip to the UPS output with the UPS input connected to an adjacent isolator switch.
- D Cabinet racks must comprise:
 - 1 A means of being secured to floor, ceiling or overhead racking as appropriate
 - 2 Front and rear adjustable rails for equipment, providing standard 19" rack mounting
 - 3 Cable management in the front of the cabinet for routing of patch cords both horizontally and vertically. As a minimum, a 1U horizontal cable management bar and two vertical cable rings should be supplied per 2U of termination or applications presentation
 - 4 Vertical 100mm plasticised cable tray installed in each side of the rack
 - 5 8 outlet power strips on both sides of the rack, providing a minimum of sixteen 13-amp power outlets.
 - 6 A rack mounted 1 kVA UPS capable of providing standby power to the active equipment in each CWC for at least 10 minutes at full load
 - 7 Cabinets shall be earthed
 - 8 Each cabinet shall be provided with a documentation wallet to be located inside the cabinet, in an accessible location
 - 9 Each equipment cabinet shall be provided with a 1U blanking plate to be located at the top of the cabinet and engraved with an identification code to be confirmed.

W31.2.11 HORIZONTAL DISTRIBUTION CABLE INSTALLATION

- A Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.
- B Provide cable ways. The cable ways shall not be filled greater than the relevant system standard maximum fill for the particular raceway type or 40%.

- C Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.
- D Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.
- E The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
- F If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 1.2 to 1.5 metre intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.
- G Horizontal distribution cables shall be bundled in-groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation in the bottom cables within the bundle and degrade cable performance.
- H Cable shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarms conduit, boxes, or other control devices.
- I Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, install appropriate carriers to support the cabling.
- J Replace any cable damaged or exceeding recommended installation parameters during installation prior to final acceptance at no additional cost.
- K Cables shall be identified by a self-adhesive label in accordance with the System Documentation section of this specification and the relevant system documentation and administration standard. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.

W31.3 PART 3 – EXECUTION

W31.3.1 SYSTEM DOCUMENTATION

- A The following section describes the installation, administration, testing, and as-built documentation required to be produced and/or maintained during the course of the installation.

W31.3.2 TERMINATION HARDWARE INSTALLATION

- A All copper and fibre cable and termination and management hardware shall be installed in the following manner:
- 1 Cables shall be dressed and terminated in accordance with the recommendations made in the relevant cabling system standard, manufacturer's recommendations and best industry practice. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame
 - 2 Each cable shall be clearly labelled on the cable jack behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labelled within the bundle, where the label is obscured from view shall not be acceptable.

W31.3.3 INSTALLATION SPECIFICATIONS

- A Cabinet racks shall be installed in the following manner:
- 1 Racks shall be securely attached to the floor
 - 2 All racks shall be grounded to the telecommunications ground bus bar in accordance with this document
 - 3 Rack mount screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.
- B Open frame racks shall be installed in the following manner:
- 1 Racks shall be securely attached to the floor
 - 2 All racks shall be grounded to the telecommunications ground bus bar in accordance with this document
 - 3 Rack mount screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.

W31.3.4 WORK AREA OUTLET INSTALLATION

- A All outlets shall be wired to the T568B wiring scheme. Outlets shall be to the relevant system performance. Modular jacks shall be terminated using an IDC termination, 110-style PC board connector, colour-coded for the T568B wiring scheme. The 110 IDC termination will accommodate 22-26 AWG solid conductor copper cables with a maximum installation diameter of 1.27mm (0.050 inches).
- B User-end faceplates shall be 8-position modular jacks and shall meet the performance requirements listed in the relevant performance requirements. Outlets may be colour-coded if required.

W31.3.5 USER OUTLET PRESENTATION

- A Be responsible for supplying and installing a suitable faceplate and back-boxes to allow their RJ45 modules to be mounted within wall outlets, dado outlets and floor boxes.

W31.3.6 USER OUTLET TERMINATIONS

- A All four pairs of the UTP cable shall be terminated onto the rear of the faceplate via insulation displacement connection (IDC) techniques.
- B The cables shall be terminated as per the EIA/TIA 568C wiring scheme so that the presentation of the pairs on the RJ45 socket matches that of the RJ45 patch panels in the wiring closets.
- C All terminations and degree to which sheathing is cut back to facilitate termination shall confirm to the manufacturer's specification to meet the required transmission standard.

W31.3.7 CABLE SYSTEM TESTING

- A There are two forms of testing that shall take place during the execution of this contract: installation testing and acceptance testing:
 - 1 Installation testing
 - 2 Acceptance testing – to be witnessed by the CA. Note that acceptance testing may involve retesting up to 10% of the entire installation and may involve demonstrating system operation using live equipment.
- B All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of the relevant standard and the manufacturer's recommended testing procedures. All UTP, STP ports and all optical fibres shall be tested. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.
- C All cables shall be tested in accordance with this document, the ANSI/TIA/EIA standards and prove the link performance characteristics defined within EN 50173 and shall be compliant with EIA/TIA Technical Services Bulletin 67 (TSB67) or current relevant testing standard. If any of these are in conflict, bring any discrepancies to the attention of the CA for clarification and resolution.
- D In the event of an individual outlet failing a test and requiring re-termination, outlets on either side of the faulty outlet shall re-tested. In the event of a cable requiring replacement during or after testing then all cables / outlets in the cable group must be re-tested.
- E All test procedures must be agreed with the CA prior to the commencement of testing.

W31.3.8 TESTING

- A Subsequent to the installation and termination of the UTP cables, all cables shall be tested. The test results shall be tabulated in a neat and legible form and signed by the Contractor's representative as a true and accurate record of the installation. This should be a 100% test of each end to end cable system and include patch and fly leads were provided by the contractor.
- B The tests for each UTP cable run out shall, as a minimum, comprise:
 - 1 End to end connectivity (continuity, pair reversals, short circuits)
 - 2 Correct pin out (all eight wires)
 - 3 Length
 - 4 Near end crosstalk
 - 5 Attenuation
 - 6 Maximum data transmission speed.
- C Tester settings should also be recorded for each test so that results can be faithfully repeated. 100% of cables must be tested from both ends. The results form will record:
 - 1 All setting of the test equipment, in order that the test may be exactly recreated if necessary
 - 2 The end of the cable at which the source is located

- 3 The measured cable length
- 4 Attenuation (dB)
- 5 A plot of the near end cross-talk (dB) across the frequency range 1 to 100 MHz, measured in steps of 500 KHz, which shall be attached to the results form
- 6 The measured DC resistance of the cable.

W31.3.9 SPECIFIC REQUIREMENTS FOR FIBRE OPTIC TESTING

- A Make provision for testing each individually terminated fibre to provide and certify a hardcopy OTDR (Optical Time Domain Reflectometer) trace attaining the minimum parameters for attenuation as tabled below. Also, the refractive index of each fibre is required.
- B In addition, the attenuation of each cable shall be measured at both 850nm and 1300nm using a light source / power meter. The test results shall be tabulated in a neat and legible form and signed by the Contractor's representative as a record of the installation. This shall be a 100% test. Testing shall be carried out from each end of every fibre.
- C Tests shall be carried on each optic fibre prior to installation and after installation and termination. Overall testing and warranty of the system shall be end to end including STII or SC terminations and patch leads.

- D Multi-mode:

Fibre Size	Attenuation at 850 NM	Bandwidth at 850 NM	Attenuation at 1300 NM	Bandwidth at 1300 NM	Splice Loss
62.5 / 125	<3.5dB/km	>160Mhz km	<1.0dB/km	>600Mhz / km	<0.2db

- E Provide the manufacturer's certification of bandwidth.
- F Test settings should also be recorded for each test so that results can be faithfully repeated.
- G The results form will record:
- 1 The unique identifier of the fibre optic cable and fibre number
 - 2 The name of the person conducting the test
 - 3 The type and manufacture of the cable being tested
 - 4 The date of the test
 - 5 All settings of the test equipment so that the test may be exactly recreated if necessary
 - 6 The end of the cable from which the test is carried out
 - 7 The measured cable length
 - 8 The attenuation at 850nm and 1300nm (dB) as appropriate
 - 9 The Bandwidth at 850nm and 1300nm (MHz km) as appropriate
 - 10 A copy of the OTDR trace.
- H Provide all necessary test equipment. All test equipment shall be calibrated. The calibration certificate shall form part of the results record.
- I Individual cable test results need not be provided in paper format. Rather, the results should be provided in electronic format. It is, however, mandatory that the results are formatted in a database type structure on the disc and that a means of searching for individual results is provided.

W31.3.10 COPPER

- A All twisted-pair copper cable links shall be tested for community, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Horizontal cabling shall be tested using the correct level field test unit to match the performance of the installed cabling system. A Category 5e/Class D cabling system will require a level II test unit and a Category 6/Class E cabling system will require a level III test unit.

W31.3.11 CONTINUITY

- A Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. Shielded/screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.

W31.3.12 LENGTH

- A Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall confirm the maximum distances set forth in the relevant system Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.

W31.3.13 TEST RESULTS

- A Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the relevant system standard. The results shall be shown as pass/fail. Test results shall be obtained directly from the test unit or from a download file using an application from the test equipment manufacturer. The test results shall include all tests performed, the expected test result and the actual test result achieved. The test results should be presented both in hardcopy printouts and electronic data on appropriate media.

W31.3.14 EARTHING AND BONDING REQUIREMENTS

- A The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to bond all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical and building earth and shall be designed in accordance with the recommendations contained in the relevant Telecommunications Bonding and Grounding Standard.

W31.3.15 PRODUCT SPECIFICATIONS

- A All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the TR or ER shall be grounded to the respective TGB or TMGB using a minimum 16mm sq. stranded copper bonding conductor and compression connectors.
- B All wires used for telecommunications grounding purposes shall be identified with a cream insulation. Non-insulated wires shall be identified at each termination point with a wrap of white tape. All cables and busbars shall be identified and labelled in accordance with the System Documentation Section of this specification.

W31.3.16 EARTHING SYSTEM INSTALLATION

- A The earthing and bonding system should be designed and approved by a BICSI Registered Communications Distribution Designer (RCDD) and shall adhere to the recommendations of the relevant standard and shall be installed in accordance with best industry practice.
- B Installation and termination of the main bonding conductor to the building service entrance ground shall be performed by a licensed electrical contractor.

W31.3.17 CABLE SYSTEM LABELLING

- A Request, in advance, the appropriate reference descriptions to be used on all aspects of the installations including cabling, cabinets, racks, patch frames. This includes, but is not limited to, the following requirements:
- B The labelling system shall clearly identify all components of the system: racks, cables, panels and outlets.
- C The labelling system shall designate the cables origin and destination and a unique identifier for the cable within the system.
- D Racks and patch panels shall be labelled to identify the location within the cable system infrastructure.
- E All labelling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labelling scheme.
- F All label printing shall be machine generated using indelible ink ribbons or cartridges. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end.
- G Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device.

W31.3.18 COMPLETION DOCUMENTATION

- A On completion of the works and prior to acceptance by the CA, submit two copies of all records and schematics for this part of the installation.
- B Schematics will detail all cable runs and termination points. The installed cable capacity, cable identification reference, length and type of cable shall be identified.
- C Records will show clearly all cable terminations and cross connections together with cable capacity and installed length.
- D The following documentation is required:
 - 1 Cabling schematics
 - 2 Cable records
 - 3 As fitted drawings
 - 4 Cable test results
 - 5 Patch Schedules
 - 6 Patch frame layouts / Cabinet Layouts
 - 7 All relevant operating and maintenance manuals.
- E All documentation and drawings will be required in electronics format, i.e. CD-ROM disk. Full details of CAD formats will be provided (see below). All drawings shall be "as fitted" and shall take account of all changes and variations.

W31.3.19 TEST DOCUMENTATION

- A Provide test documentation on disk within three weeks after the completion of the project. The disk shall be clearly marked on the outside front cover of the words "Project Test Documentation", the project name, and the date of completion (month and year). The results shall be divided by major heading: Horizontal and Backbone. Each major heading shall be further sectioned by the test type. Within the horizontal and backbone sections, scanner test results (Category 3/Class C, 5e/Class D or 6/Class E), optical fibre attenuation test results and shall be segregated. Test data within each section shall be presented in the sequence listed in the administration records.
- B The test equipment name, manufacturer, model number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test

document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.

- C OTDR test results, if required, shall be printed or attached and copied on A4 paper and included in a test documentation binder.
- D When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

W31.3.20 WARRANTY AND SERVICES

- A Provide the following warranty covering the installed cabling system against defects in workmanship, components, and performance, and follow-on support after project completion.

W31.3.21 INSTALLATION WARRANTY

- A Warrant the cabling system against defects in workmanship. The warranty shall cover all labour and materials necessary to correct a failed portion of the system due to installation problems and to demonstrate performance within the original installation specifications after repairs are accomplished. This warranty shall be provided at no additional cost to the Client.

W31.3.22 CABLING SYSTEM WARRANTY

- A Provide a manufacturer's warranty in excess of 15 years. An extended product warranty shall be provided which warrants functionality of all components used in the system for 20 years from the date of registration. The Applications Assurance Warranty shall warrant the installed 100MHz horizontal copper, and both the horizontal and the backbone optical fibre portions of the cabling system. Copper links shall be warranted against the link performance minimum expected results defined in the relevant system standard in effect at time of project commencement. Optical fibre links shall be warranted against the link and segment performance minimum expected results defined in the relevant system standard in effect at the time of project commencement. The Applications Assurance Warranty and the Extended Product Warranty must include the labour cost and materials to replace or repair defective components for the life of the warranty.
- B Contractors able to incorporate the fibre optic distribution scheme within the Copper 'Applications and Performance Warranty' should clearly declare this fact.

W31.3.23 CONTINUING MAINTENANCE

- A Furnish an hourly rate with the proposal submittal, which shall be valid for a period of one year from the date of acceptance. This rate will be used when cabling support is required to affect moves, additions and changes to the system (MACs). MACs performed by the Contractor shall be added to the Contractor's and the manufacturer's warranty.

W31.3.24 CABLING SYSTEM ACCEPTANCE

- A The CA will make periodic inspection of the project in progress. One inspection will be performed at the conclusion of cable pulling, prior to closing of the false ceiling, to inspect the method of cable routing and support, and the fire-stopping of penetrations. A second inspection will be performed at completion of cable termination to validate that cables were dressed and terminated in accordance with TIA/EIA specifications for jacket removal and pair untwist, compliance with manufacturer's minimum bend radius, and that cable ends are dressed neatly and orderly.

W31.3.25 FINAL INSPECTION

- A Upon completion of the project, the CA will perform a final inspection of the installed cabling system. The final inspection will be performed to validate that all horizontal and backbone cables were installed as defined in the drawing package and that the installation meets aesthetic expectations.

W31.3.26 TEST VERIFICATION

- A Upon receipt of the test documentation, the CA reserves the right to perform spot testing of a representative sample of the cabling system to validate test results provided in the test document. Testing will use the same method employed by the contractor, and minor variations will be allowed to account for differences in test equipment. If significant discrepancies are found the contractor will be notified for resolution.

W31.3.27 SYSTEM PERFORMANCE

- A During the three-week period between final inspection and delivery of the test and as-built documentation, activate the cabling system. The CA will test the operation of the cabling system during this period.

W31.3.28 FINAL ACCEPTANCE

- A Completion of the following will constitute acceptance of the system:
- 1 The whole installation
 - 2 In-progress and final inspections
 - 3 Receipt of the test and as-built documentation
 - 4 Successful performance of the cabling system for a two-week period
 - 5 Supply and installation of equipment cabinets in line with the specification to be installed within the defined LDF spaces on each floor
 - 6 Supply and installation of patching frames
 - 7 Supply and installation, termination, testing, documentation and warranty of the structured cabling scheme
 - 8 Supply and installation of fibre backbone cables
 - 9 Supply and installation and testing of patch cables
 - 10 Supply and installation, testing and documentation of the multi-pair copper backbone cable.

W60 LIGHTNING PROTECTION

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W60.1 PART 1- GENERAL

W60.1.1 RELATED DOCUMENTS

- A Drawings and general provisions of the Contract, including main Contract Preliminaries and section A of this specification.
- B For performance details and physical sizes of plant and equipment refer to section D "Schedules of Equipment"
- C For system descriptions, operating parameters and ambient temperatures refer to section B of this specification and the Schedules of Equipment.
- D Provide operating and maintenance manuals including record drawings of the entire Lightning Protection system.
- E The lightning protection system shall be installed in stages where construction sequence requires; reference shall be made to the main contract preliminaries for details of the project construction program.
- F Refer also to the following sections:
 - 1 V11 "Low Voltage Connection"
 - 2 V30 "Low Voltage Distribution System"
 - 3 V31 "Low Voltage Switchgear"
 - 4 V33 "Busbar Trunking"
 - 5 V36 "Automatic Power Factor Correction"
 - 6 V37 "Harmonic Filtering Equipment"
 - 7 V80 "Electrical Identification"
 - 8 V81 "Earthing and Bonding Systems"
 - 9 Y41 "Building Monitoring and Management"
 - 10 Y50 Electrical Commissioning
 - 11 Y61 "LV and ELV cables"
 - 12 Y63 "Cable Supports"
 - 13 Y67 "Transient over-voltage surge suppression devices"
 - 14 Y90 "Fixing to buildings".

W60.1.2 SUMMARY

- A Design, supply, install, test and commission a complete lightning protection system in accordance with the drawings and this specification. Ensure risk assessment is carried out and lightning protection systems (LPSs) are provided in accordance with BS EN 62305 (refer to below and Section A Preliminaries of this specification).
- B The lightning protection specialist shall assess the risk and design an appropriate lightning protection system using copies of all structural, facade and Architectural drawings. The lightning protection system shall encompass all structural elements within each building to form a Faraday cage, all structural elements shall be bonded together to ensure electrical continuity in the event of a lightning strike.
- C The system shall comprise the following elements:
 - 1 Air Terminal strike plates
 - 2 Air Termination network
 - 3 Structural columns
 - 4 Structural slabs
 - 5 Reinforced Concrete columns
 - 6 Reinforced Concrete slabs
 - 7 Façade
 - 8 Roof steelwork

- 9 Down conductors
- 10 Earth Pits
- 11 Bi metallic test clamps.

D The system and equipment shall be designed, supplied, installed, commissioned and tested in accordance with BS EN 62305 and BS 7430.

W60.1.3 DEFINITIONS

- A HV: High voltage in excess of 1Kv.
- B LV: Low Voltage: 0-1000V.
- C XLPE: Cross-linked Polyethylene.
- D LSF: Low Smoke and Fume.
- E LPS: Lightning Protection System.
- F CA: Contract Administrator.
- G EMP – Electromagnetic Pulse.
- H ABD -Avalanche Breakdown Diode.
- I MOV – Metal Oxide Varistors.
- J TSS - Thyristor Surge Suppressors.
- K TOPS –Transient overvoltage Protection System.

W60.1.4 SUBMITTALS

- A Product Data: For each type of product indicated.
- B Shop Drawings: For air terminals and mounting accessories:
 - 1 Layout of the lightning protection system, along with details of the components to be used in the installation
 - 2 Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by BS EN 62305 for bonding of earthed and isolated metal bodies.
- C Qualification Data: For qualified Installer and manufacturer. Include certification by background information confirming projects undertaken in region.
- D Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.
- E Field quality-control reports.
- F Comply with recommendations in BS EN 62305, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.
- G Other Informational Submittals: Plans showing dimensioned as-built locations of earthing features, including the following:
 - 1 Earth electrodes
 - 2 Earth loop conductor.

W60.1.5 QUALITY ASSURANCE

- A Acceptable manufacturers: Firms regularly engaged in manufacture of equipment required for this installation, whose products have been in satisfactory use in similar service for not less than 10 years.

Provide equipment produced by a manufacturer listed as an Acceptable Manufacturer in this Section and as approved by the CA.

- B Standards Compliance: Comply with requirements of applicable local codes, BS EN 62305 and regulations pertaining to lightning protection systems.
- C Lightning Protection System: System shall be installed by trades specializing in lightning protection systems.
- D In case of conflict among the referenced standards and codes, the more stringent provision will govern.
- E Ensure that the design, construction, materials and finishes of all equipment are suitable for the location, climatic and operating conditions to which the installation will be exposed.
- F Ensure that the whole installation complies with the relevant standards, including the following:
 - 1 BS 951 - Electrical earthing. Clamps for earthing and bonding
 - 2 BS 1377 - Methods of test for soils for civil engineering purposes
 - 3 BS 6004 - Electric cables. PVC insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring
 - 4 BS 7430 - Code of practice for earthing
 - 5 BS 7671+A2 - Requirements for electrical installations. IEE Wiring Regulations. Seventeenth edition
 - 6 BS EN 12163 - Copper and copper alloys. Rod for general purposes
 - 7 BS EN 50164-1 - Lightning protection components (LPC). Requirements for connection components
 - 8 BS EN 50164-2 - Lightning protection components (LPC). Requirements for conductors and earth electrodes
 - 9 BS EN 50164-3 +A1 - Lightning protection components (LPC). Requirements for isolating spark gaps
 - 10 BS EN 50174-1 - Information technology. Cabling installation. Specification and quality assurance
 - 11 BS EN 50174-2 - Information technology. Cabling installation. Installation planning and practices inside buildings
 - 12 BS EN 50174-3 - Information technology. Cabling installation. Installation planning and practices outside buildings
 - 13 BS EN 50310 - Application of equipotential bonding and earthing in buildings with information technology equipment
 - 14 BS EN 60228 - Conductors of insulated cables
 - 15 BS EN 60529 - Specification for degrees of protection provided by enclosures (IP code)
 - 16 BS EN 61643-11 - Low voltage surge protective devices. Surge protective devices connected to low-voltage power systems. Requirements and tests
 - 17 BS EN 61663-1 - Lightning protection. Telecommunication lines. Fibre optic installations
 - 18 BS EN 61663-2 - Lightning protection. Telecommunication lines. Lines using metallic conductors
 - 19 BS EN 62305-1 - Protection against lightning. General requirements
 - 20 BS EN 62305-2 - Protection against lightning. Risk management
 - 21 BS EN 62305-3 - Protection against lightning. Physical damage to structures and life hazard
 - 22 BS EN 62305-4 - Protection against lightning. Electrical and electronic systems within structures
 - 23 BS EN 80416-1 - Basic principles for graphical symbols for use on equipment. Creation of symbol originals
 - 24 BS EN 80416-2 - Basic principles for graphical symbols for use on equipment. Form and use of arrows
 - 25 BS EN 80416-3 - Basic principles for graphical symbols for use on equipment. Guidelines for the application of graphical symbols
 - 26 TIA/EIA J-STD-607 - Commercial Building Earthing and Bonding Requirements for Telecommunications.

W60.1.6 CO-ORDINATION

- A Co-ordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

- B Co-ordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.
- C Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

W60.2 PART 2 – PRODUCTS

W60.2.1 ACCEPTABLE MANUFACTURERS

- A Available Manufacturers: Subject to compliance with requirements provide products by one of the following:
- 1 A N Wallis & Co Ltd
 - 2 Furse
 - 3 Omega.

W60.2.2 COMPONENT PARTS

- A The principal components of lightning protection system shall be as follows:
- 1 Air terminations
 - 2 Down conductors
 - 3 Joints and bonds
 - 4 Structural columns
 - 5 Structural slabs
 - 6 Reinforced Concrete columns
 - 7 Reinforced Concrete slabs
 - 8 Façade
 - 9 Roof steelwork
 - 10 Bi metallic test clamps
 - 11 Test joints.
 - 12 Earth terminations
 - 13 Earth electrodes
 - 14 Earthing pit
 - 15 Air Termination network.

W60.2.3 AIR TERMINATIONS

- A Air terminations shall consist of horizontal conductors in the form of networks as per British standard: BS EN 62305.
- B No part of the roof should be more than 5 meters from the nearest horizontal conductor; this will be achieved typically by an air termination network mesh of approximately 10-meter x 20 meter.

W60.2.4 DOWN CONDUCTORS

- A The BS EN 62305 code covers the use of down conductors of various types including the use of strips, rod, reinforcing bars and structural steel stanchions. Any good conductor which may form part of the building structure can be included, appropriately joined to the air and earth terminations and in general the higher the number of down conductors used, the lower the risk of side-flashing and other undesirable phenomena.
- B Likewise, large conductors reduce the risk of side-flashing especially if insulated.
- C The down conductor system should, where practicable, be directly routed from the air termination to the earth termination network and be symmetrically placed around the outside walls of the structure starting from the corners.
- D Pattern and number of down conductors, joints, bonds and test joints shall be as per the recommendations of BS EN 62305.

W60.2.5 EARTH TERMINATION NETWORK

- A Certain piles identified on the Electrical and structural engineer's drawings shall be used as earth electrodes and shall be connected to the relevant down conductor, these generally comprise reinforcing in the building structure.
- B The whole of the earth termination network should have a combined resistance to earth not exceeding 10 (ten) ohms without taking account of any bonding to other services. Reference shall be made to BS EN 62305 for further details.

W60.2.6 EARTH ELECTRODES

- A The earth electrodes should be driven into the ground beneath, or as close as practicable to, the structure and down conductor where ground conditions are favourable for the use of rods in parallel, the reduction in earth resistance is small when the separation between the rods becomes less than their driven length.
- B Earthing electrodes shall be copper clad steel 20mm minimum diameter, 3m (metre) length.

W60.2.7 CONNECTORS/FITTINGS/FASTENERS AND HARDWARE

- A Provide all connectors, fittings, fasteners, hardware, clamps, guards, lugs, etc., as required to connect, interconnect and install all parts of the system (maximum cable fasteners spacing - 1 metre).
- B Fabricated from copper metal and approved for use intended.
- C Provide connections rated and approved for application between dissimilar metals.

W60.3 PART 3 – EXECUTION

W60.3.1 INSPECTION

- A Examine conditions where lightning protection system is to be installed. Notify CA in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

W60.3.2 INSTALLATION

- A Install lightning protection system as indicated, in accordance with manufacturer's written instructions, and in accordance with local authority requirements to ensure that installation complies with requirements and serves intended function.
- B Coordinate as necessary to interface installation of the lightning protection system with the building architecture, structure, roof equipment and earthing.
- C Install conductors with more than one direct path from air termination to earth connections avoiding sharp bends and narrow loops. Conceal all conductor drops to earth within building structure as indicated. Provide flush cable support boxes with gaskets and bolted cast covers, finish as directed by Architect.
- D Properly guard and protect all work installed in accessible locations.
- E Install all material in a manner to prevent electrolytic action under the presence of moisture.
- F Make all roof, wall or other penetration in a manner to prevent the ingress of water or moisture.
- G Install lightning protection system so that completed work is unobtrusive and does not detract from the building's appearance.
- H Make installation in a manner to eliminate possibility of displacement and subsequent maintenance.
- I Make all connections mechanically and electrically sound and clean all bonding surfaces just prior to attachment.
- J Conductors:
- 1 Install conductors to earth pits (Test Pits only) within MDPE pipe or UPVC conduit, cover extent of cable route with cable warning tape and cable markers at ground level. Cable markers shall be provided every 20 metres and at change of direction
 - 2 Cables on flat roof areas shall be run exposed. Fasteners shall be fixed in accordance with BS EN 62305 and manufacturer's recommendations. Colour of tape sheath and fasteners to be white and agreed with the Architect.
- K Earth Electrode:
- 1 Drive to full depth in soil undisturbed by building excavation; do not drive into excavation backfill area. The contractor shall be responsible for carrying out soil resistivity tests prior to the installation of any earth electrodes
 - 2 Provide triangular grid consisting of 3 earth electrodes located as indicated on the drawings
 - 3 Provide connection between grid and water service and equipment earth grid
 - 4 Provide grid resistance of 10 ohms or less as a final value
 - 5 Install top of earth electrodes at least 75cm below finished grade complete with access. All earth electrodes to be installed within concrete lightning protection earth pit complete with stainless steel identification label. The final location of earth rods and pits shall be agreed with the Landscape and main Architects.

W60.3.3 FIELD QUALITY CONTROL

- A Upon completion of lightning protection system, test system to demonstrate compliance with specifications. When possible, field correct defective equipment, then re-test to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected at no additional cost to Owner.
- B Check continuity of entire system.
- C Inspect all connections prior to concealing same and ensure compliance with all applicable sections of this specification.
- D Perform an earth resistance test immediately after driving earth electrodes and furnish test results to CA.
- E Install equipment under direct supervision of the equipment manufacturer's factory representative.
- F Fully test the complete lightning protection system in the presence of the CA or their representative to demonstrate continuity of all conductors. Submit a written test report in format approved by CA.

W60.3.4 CORROSION PROTECTION

- A Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

Y60 CONDUIT AND TRUNKING

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Y60.1 PART 1 - GENERAL

Y60.1.1 RELATED DOCUMENTS

- A Drawings and general provisions of the Contract, including main Contract Preliminaries and section A of this specification.
- B For performance details and physical sizes of cables trunking and equipment refer to drawings and this specification. For cable details refer to section D "Schedules of Equipment".
- 1 For system application selections schedules, operating parameters and ambient temperatures refer to section B of this specification.
- C Refer also to the following sections:
- | | | |
|---|------------------------------------|-----|
| 1 | Low Voltage Distribution: | V30 |
| 2 | Electrical Identification: | V80 |
| 3 | Earthing and Bonding Systems: | V81 |
| 4 | Electrical Inspection and Testing: | Y50 |
| 5 | LV and ELV Cables: | Y61 |
| 6 | Cable Supports | Y63 |
| 7 | Electrical Accessories: | Y65 |
| 8 | Fixing to Building Fabric: | Y90 |

Y60.1.2 SUMMARY

- A This Section includes the following for electrical wiring:
- 1 Conduits, fittings, boxes, enclosures
- 2 Cable trunking, fittings and accessories
- 3 Perimeter trunking
- 4 Underfloor trunking.
- B Refer also to the following sections:
- 1 For underfloor busbar trunking systems: V40 "Small Power"
- 2 For Busbars generally: V33 "Busbars"
- C For details of fire stopping for trunking and conduits passing through fire rated walls and floors refer to Y90.

Y60.1.3 DEFINITIONS

- A **Conduit:** An electrical conduit is a tube used to protect and distribute electrical wiring. Electrical conduit may be made of metal or plastic. Most conduits are rigid, but flexible conduit is used for some purposes as indicated in this specification.
- B **Cable trunking:** A lidded assembly comprising a trunking length and possibly other system components to provide an enclosure for the accommodation and laying in of insulated conductors and cables and possibly the accommodation of other electrical equipment.
- C **Perimeter Trunking:** A wall mounted multi-compartment trunking system to provide a cable management system to convey data, power and communication cabling at skirting or above desk (dado) height.
- D **Underfloor trunking:** A buried in the screed or surface mounted in a floor void, multi-compartment trunking system to convey data, power and communication cabling over a floor level offering flexibility on the layout of future workstation locations.
- E **Perforated Cable tray:** A perforated metal tray with integrated side members used to support insulated cables for power distribution and communication. For applications and specification refer to Y63.

- F **Cable Ladder/rack:** An open metal rung type system with substantial side members offering increased loading capacity for supporting larger power distribution cables. For applications and specification refer to Y63.
- G **Cable basket:** Wire mesh type tray with sides turned up to form a basket. Generally used for smaller cables. For applications and specification refer to Y63.
- H The following acronyms are used in this specification and on the drawings:
- 1 LFH: Low Fire Hazard
 - 2 LV: Low voltage
 - 3 V0: Classification of the ignition and burning resistance
 - 4 EPDM: Ethylene-propylene-dieneterpolymer rubber
 - 5 Comms: Communications systems
 - 6 PAVA: Public Address and Voice Alarm System
 - 7 BMS: Building Management System
 - 8 NBR: Acrylonitrile-butadiene rubber.
 - 9 SWL: Safe Working Load
 - 10 PVC: Polyvinyl chloride.

Y60.1.4 PERFORMANCE REQUIREMENTS

- A To provide a system for the distribution, protection and support of a combination of cables, electrical equipment and/or communication system installations as indicated on the drawings. Where necessary cable trunking systems may be used for the segregation of cables.
- B Applications: Use as indicated on the drawings, as indicated in section B of this specification or where not shown comply with the following general applications:
- 1 **Conduits:** Use when services are surface mounted or embedded in walls or floor screeds
 - 2 **Cable trunking:** Use for final LV circuits, single cables, Data, Comms, security, fire alarm and BMS cables. Spans short and lighter loading
 - 3 **Flexible Conduit:** Use for final connections to motors, other equipment subject to vibration or adjustment and to thermostats, motorised valves and similar items mounted in pipelines or ducts
 - 4 **Cable baskets, perforated tray and ladder rack systems:** refer to section Y63 for applications
 - 5 **Perimeter trunking:** use to provide power and communication services above desk top level or at skirting level for office/workshop type areas without floor distribution systems. Installations should ensure compliance with the Disability Discrimination Act 2005 and the Building Regulations
 - 6 **Underfloor trunking:** use to provide to power and communication systems to office type areas where a flexible/adaptable layout is required.
- C Size conduits and trunking according to the number of cables being drawn in with an allowance of 25% for future spare capacity. Provide calculations to support the sizing of conduits and trunking systems.
- D Trunking support systems: Give consideration to the following factors when undertaking the design of the trunking support system although some of these (e.g. snow/wind loads) may not be relevant to every installation.
- 1 Distributed loads (eg. cables)
 - 2 Point loads
 - 3 Snow, wind and external forces
 - 4 Safety factor
 - 5 Deflection
 - 6 Spacing of supports
 - 7 Location of couplers
 - 8 Testing of cables within a support system
 - 9 Electrical continuity
 - 10 Earth protection
 - 11 Electromagnetic compatibility (EMC)
 - 12 Thermal expansion or building movement joints.

- E Provide full and detailed calculations for the loading of all cable trunking support systems. Calculations to be reviewed by structural engineer. Comply with the following:
- 1 Distributed loads: Allow both the physical space and sufficient load carrying capacity for the future addition of 25% more cables or other loading medium
 - 2 Point loads: Provide adequate support for point loads. Point loads may consist of permanent equipment, such as lighting luminaires, junction boxes or other switchgear, or temporary loads such as commissioning equipment or installation personnel
 - 3 Snow, wind and external forces: If the system is outdoors and must also sustain snow, ice, wind or other variable forces these must also be taken into account at the design stage:
 - a Appropriate design data for UK weather conditions is given in BS EN 1991.
 - 4 Safety factor: Select appropriately but never less than 1.7. Increase if installation could be subject to abuse or other external influences
 - 5 Deflection:
 - a Along the length: Never more than 1/200th of the span between supports at SWL
 - b Across the width: Never more than 1/20th of the width.
- F For trunking systems consideration must be given to a number of other factors:
- 1 Where cables cross each other such as in a tee or four way / cross, extra space will be required
 - 2 Depending upon the type of installation, future wiring needs could well require spare trunking capacity
 - 3 Larger cables, in particular, do not lie neatly and flatly. Consideration must be given to the practicality of laying cable
 - 4 A 50% reduction in capacity will apply at tees and four way / crosses unless offset fittings are used.
- G Conduits to be surface installed or buried in building structures in accordance with definite requirements of section B of this specification and as indicated on the drawings. Where no specific instructions are given comply with the following:
- 1 Occupied areas: Concealed, cast in or built into floor and wall structures
 - 2 Floor or ceiling voids, roof voids and stud partitions, accessible trenches: Concealed but surface mounted within void
 - 3 Plantroom areas: Exposed, surface mounted on walls, cast into floors
 - 4 Factories/warehouses/storage: Exposed, surface mounted on walls, cast into floors (subject to loading checks).

Y60.1.5 SUBMITTALS

- A Product Data: For cable trunking and conduits include data indicating dimensions and finishes for each type of trunking and conduit. Provide details of corrosion resistance and manufacturer's recommended selection for each type of environment into which the systems are to be installed.
- B Support Calculations:
- 1 Where cable trunking support systems are fixed to primary supports (e.g. Structural steel work or elements of the building) it is important to ensure that the primary supports are strong enough to carry the imposed loads. Submit details of all loads at the points of support and obtain approval from the structural engineer for the suitability of the support system and method of attachment to the structure
 - 2 Provide loading calculations that demonstrate the suitability of the trunking system to support the designed and future spare capacity loadings. Provide details of maximum deflection and safety factors applied.
- C Shop Drawings: For each type of conduit and cable trunking system:
- 1 Show fabrication and installation details of cable tray and conduit. Include plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
- D Samples for Initial selection:
- 1 Conduits: 300mm sample of types proposed for every environment location on the project

- 2 For cable trunking: 300mm sample with factory-applied finish and colour that are intended to be used in the installation
 - 3 Samples to include proposed finishes for each of the particular environments into which the conduits/trunking systems are to be installed
 - 4 Provide samples of each size of trunking intended to be used for the project
- E Coordination Drawings: Conduit and cable trunking routing plans, drawn to scale, on which the following items are shown and coordinated with other services installations, based on input from installers of the items involved:
- 1 Conduit dimensioned details of installation in following locations:
 - a Cast in concrete
 - b Chased into masonry walls
 - c Within floor screed
 - d Within stud partitions
 - e Locations of back boxes etc. for accessories
 - f Details when crossing fire or acoustic barriers.
 - 5 Cable trunking:
 - a Vertical and horizontal offsets and transitions
 - a Clearances for access above and to side of cable trunking
 - b Vertical elevation of cable trunking above the floor or bottom of ceiling structure.
 - c Details for crossing fire or acoustic barriers
 - 6 Co-ordination with other HVAC and electrical services.
- F Qualification Data: For professional engineer providing calculations.
- G Source quality-control test reports.

Y60.1.6 QUALITY ASSURANCE

- A Electrical Components, Devices, and Accessories: Listed and labelled as defined in BS7671, by a testing agency acceptable to authorities having local jurisdiction and marked for intended use.
- B Comply with the following standards and BS7671:
- 1 BS 1710 - Specification for identification of pipelines and services
 - 2 BS 4607-1:1984+A2: Non-metallic conduits and fittings for electrical installations. Specification for fittings and components of insulating material
 - 3 BS 4678-2: Cable trunking. Steel underfloor (duct) trunking
 - 4 BS 4678-4: Cable trunking. Specification for cable trunking made of insulating material
 - 5 BS 5733 - General Requirements for Electrical Accessories
 - 6 BS 6701: Telecommunications equipment and telecommunications cabling. Specification for installation, operation and maintenance
 - 7 BS 6946: Specification for metal channel cable support systems for electrical installations
 - 8 BS 7371-1: Coatings on metal fasteners. Specification for general requirements and selection guidelines
 - 9 BS 7671: Requirements for electrical installations. IET Wiring Regulations
 - 10 BS EN 1991-1-3: Eurocode 1. Actions on structures. General actions. Snow loads
 - 11 BS EN 1991-1-4: Eurocode 1. Actions on structures. General actions. Wind actions
 - 12 BS EN 10025-2: Hot rolled products of structural steels. Technical delivery conditions for non-alloy structural steels
 - 13 BS EN 10088-1: Stainless steels. List of stainless steels
 - 14 BS EN 10088-2: Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes
 - 15 BS EN 10088-3: Stainless steels. Technical delivery conditions for bars, rods, wire, sections and bright products of corrosion resisting steels for construction purposes
 - 16 BS EN 10143: Continuously hot-dip coated steel sheet and strip. Tolerances on dimensions and shape
 - 17 BS EN 10162 - Cold rolled steel sections. Technical delivery conditions. Dimensional and cross-sectional tolerances
 - 18 BS EN 10210 - Hot finished structural hollow sections of non-alloy and fine grain structural steels

- 19 BS EN 10244-2: Steel wire and wire products. Non-ferrous metallic coatings on steel wire. Zinc or zinc alloy coatings
- 20 BS EN 10346: Continuously hot-dip coated steel flat products. Technical delivery conditions
- 21 BS EN 50085-1: Cable trunking systems and cable ducting systems for electrical installations. General requirements
- 22 BS EN 50085-2-2: Cable trunking systems and cable ducting systems for electrical installations. Particular requirements for cable trunking systems and cable ducting systems intended for mounting underfloor, flushfloor, or onfloor
- 23 BS EN 50174-2: Information technology. Cabling installation. Installation planning and practices inside buildings
- 24 BS EN 50174-1 Information technology. Cabling installation. Installation specification and quality assurance
- 25 BS EN 60529 - Specification for degrees of protection provided by enclosures (IP code)
- 26 BS EN 60670-1 + A1: Boxes and enclosures for electrical accessories for household and similar fixed electrical installations. General requirements
- 27 BS EN 60670-22 - Boxes and enclosures for electrical accessories for household and similar fixed electrical installations. Particular requirements for connecting boxes and enclosures
- 28 BS EN 60670-23: Boxes and enclosures for electrical accessories for household and similar fixed electrical installations. Particular requirements for floor boxes and enclosures
- 29 BS EN 61386-21: +A11: Conduit systems for cable management. Particular requirements. Rigid conduit systems
- 30 BS EN 61386-23+A11: Conduit systems for cable management. Particular requirements. Flexible conduit systems
- 31 BS EN 61534-22: Powertrack systems. Particular requirements for powertrack systems intended for onfloor or underfloor installation
- 32 BS EN 61537: Cable management. Cable tray systems and cable ladder systems
- 33 BS EN 61914: Cable cleats for electrical installations
- 34 BS EN ISO 1461: Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods
- 35 BS EN ISO 2081: Metallic and other inorganic coatings. Electroplated coatings of zinc with supplementary treatments on iron or steel
- 36 BS EN ISO 12683: Mechanically deposited coatings of zinc. Specification and test methods
- 37 BS EN ISO 12944-2: Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Classification of environments
- 38 BS EN ISO 14713-1: Zinc coatings. Guidelines and recommendations for the protection against corrosion of iron and steel in structures. General principles of design and corrosion resistance
- 39 BS EN ISO 17668: Zinc diffusion coatings on ferrous products. Sherardizing. Specification
- 40 PD 6484: 'Commentary on corrosion at bimetallic contacts and its alleviation.'

Y60.1.7 DELIVERY, STORAGE, AND HANDLING

- A Store all trunking and conduit indoors in a dry and well-ventilated location to prevent water or other foreign materials from staining or adhering to cable tray. Unpack and dry wet materials before storage.

Y60.2 PART 2 – PRODUCTS

Y60.2.1 CONDUITS GENERAL

- A Material selection: Conduits to be of the following types depending upon the application/location and environment into which they are to be located. Refer also to the requirements indicated in section B of this specification:
- 1 **Steel with black enamel finish:** Not to be used without written authorisation from the CA. Where authorised it is only suitable for indoor dry locations exposed to view
 - 2 **Galvanised Steel:** Use for all normal environments including damp locations and where concealed in concrete, screed, masonry walls, ceiling and floor voids
 - 3 **Stainless steel:** use where exposed to harsh marine or swimming pool environment or heavily polluted environments. Use also in food production areas where exposed to view
 - 4 **PVC:** Not to be used without the written authorisation from the CA. Where authorised, it is only suitable for locations with low risk of damage abrasion or impact from public or personnel within the environment. If permitted use oval conduit for protecting cables chased into walls
 - 5 **Flexible Conduit:** Use flexible conduit for final connections to motors, other equipment subject to vibration or adjustment and to thermostats, motorised valves and similar items mounted in pipelines or ducts.
- B The effect of electromagnetic interference from non-metallic trunking and conduits should be evaluated before they are used. Electromagnetic energy can be radiated from or absorbed by wiring systems unless they are adequately screened and earthed.
- C All conduits to be installed strictly in accordance with manufacturer's instructions and shall be obtained from a single manufacturer for each type.

Y60.2.2 BLACK ENAMEL CONDUIT

- A Description: Black enamel rigid steel conduit. For restrictions in use see Y60.2.2: Manufacturers:
- 1 Barton (Hub Le Bas)
 - 2 Unitrunk
- B Standards:
- 1 BS EN 61386-1, BS EN 61386 -21.
- C Construction:
- 1 Material: Steel Black enamel inside and out
 - 2 Finish Class: Corrosion resistance Class 2
 - 3 Resistance to compression: Class 5
 - 4 Resistance to impact: Class 5
 - 5 Tensile strength: Class 5
 - 6 Jointing: screwed ends
 - 7 Suitable for bending
 - 8 Electrical characteristics: with electrical continuity
 - 9 Dimensions: Standard Sizes:
 - a 20mm
 - b 25mm
 - c 32mm.
- D Fittings & Accessories:
- 1 Fittings: Couplers, bends and tee to match conduit grade and finish:
 - a Use solid couplers to join lengths of conduit.
 - 2 Accessories: Terminal, loop in, extension, back outlet, angle boxes etc:
 - a Material: Malleable iron
 - b Ensure fittings are same class and finish as associated conduit system

- c Supply covers for circular or adaptable boxes in the same material and finish as boxes
 - d Bushes, locknuts and lock rings: Brass
 - e Limit number of entry holes within loop-in boxes to four.
- 3 Adaptable box: Steel, Black enamel with lids secured by mushroom head screws.
 - a minimum size – 75x75x 50mm.
- E Do not use in exterior locations or in areas of continual dampness.
- F Connections:
 - 1 Use couplers and externally screwed brass bushes to connect conduit to loop-in circular conduit boxes, switchgear, distribution boards, and adaptable boxes
 - 2 Use solid couplers.
 - 3 Conduit fixing saddles - Spacer bar
 - 4 Plugs - Hexagonal malleable iron
 - 5 Locknuts - Hexagonal steel.

Y60.2.3 GALVANISED METAL CONDUIT SYSTEMS

- A Description: Galvanised heavy grade rigid conduit systems: For restrictions in use see Y60.2.2: Manufacturers:
 - 1 Barton (Hub Le Bas)
 - 2 Unitrunk
 - 3 Deta Electrical Co Ltd
 - 4 MK Electric
- B Standards:
 - 1 BS EN 61386-1, -21,
 - 2 BS 4568-1: steel conduit and fittings with metric threads
 - 3 BS EN 50086
- C Construction:
 - 1 Material: Steel hot dipped galvanised inside and out
 - 2 Finish Class: Corrosion resistance Class 4
 - 3 Resistance to compression: Class 5
 - 4 Resistance to impact: Class 5
 - 5 Tensile strength: Class 5
 - 6 Jointing: screwed ends.
 - 7 Suitable for bending
 - 8 Electrical characteristics: with electrical continuity
 - 9 Dimensions: Standard Sizes:
 - a 20mm
 - b 25mm
 - c 32mm.
- D Fittings & Accessories:
 - 1 Fittings: Couplers, bends and tee to match conduit grade and finish:
 - a Use solid couplers to join lengths of conduit.
 - 2 Accessories: Terminal, loop in, extension, back outlet, angle boxes etc:
 - a Material: Malleable iron
 - b Ensure fittings are same class and finish as associated conduit system
 - c Supply covers for circular or adaptable boxes in the same material and finish as boxes
 - d Bushes, locknuts and lock rings: Brass
 - e Limit number of entry holes within loop-in boxes to four
 - 3 Adaptable box: Steel, hot dipped galvanised with lids secured by mushroom head screws.
 - a minimum size – 75 x75x 50mm.
- E In exterior locations or in areas of continual dampness provide weatherproof seals/gaskets

- F Connections:
- 1 Use couplers and externally screwed brass bushes to connect conduit to loop-in circular conduit boxes, switchgear, distribution boards, and adaptable boxes
 - 2 Use solid couplers
 - 3 Conduit fixing saddles - Spacer bar
 - 4 Plugs - Hexagonal malleable iron
 - 5 Locknuts - Hexagonal steel.

Y60.2.4 STAINLESS STEEL CONDUIT

- A Description: Metric sized stainless steel threaded rigid conduit systems: For locations to be installed see Y60.2.2. Manufacturers:

- 1 Electrix
- 2 CSi Ltd
- 3 Lasnek

- B Standards:

- 1 BS EN 61386-1, -21.

- C Construction:

- 1 Material: Stainless Steel: Select type to suit the installed environment:
 - a Type 316L: BS EN 10088 Grade 1-4404
 - b Type 304L: BS EN 10088 Grade 1-4301.
- 2 Finish Class: Satin (brushed)- 3D
- 3 Resistance to ingress of water:
 - a BS EN 60529: Conduits giving protection against water jets (IPX5).
- 4 Resistance against corrosive or polluting substances:
 - a Resistance against corrosive or polluting substances:
 - Conduits with same protection outside and inside
 - High protection - stainless steel.
- 5 Jointing: screwed ends. ISO thread: 1.5mm pitch
- 6 Suitable for bending
- 7 Electrical characteristics: with electrical continuity
- 8 Dimensions: Standard Sizes:
 - a 20mm
 - b 25mm
 - c 32mm
 - d 50mm.

- D Fittings & Accessories:

- 1 Fittings: Couplers, bends and tee to match conduit grade and finish:
 - a Use solid couplers to join lengths of conduit.
- 2 Accessories: Terminal, loop in, extension, back outlet, angle boxes etc:
 - a Material: Stainless steel
 - b Ensure fittings are same class and finish as associated conduit system
 - c Supply covers for circular or adaptable boxes in the same material and finish as boxes
 - d Bushes, locknuts and lock rings: Stainless steel
 - e Limit number of entry holes within loop-in boxes to four.

- E In exterior locations or in areas of continual dampness provide weatherproof seals/gaskets to give IP66 rating.

Y60.2.5 PVCu CONDUIT

- A Description: High impact PVCu conduit and fittings, round section systems for general applications and light gauge oval section for domestic applications. For restriction in use see Y60.2.2 Manufacturers:

- 1 Legrand
- 2 Marshall-Tufflex
- 3 MK Electric
- 4 Schneider Electric

B

Standards:

- a BS EN 61386-1, -21
- b BS EN 50085 part 1
- c BS EN 50085 Part 2-1
- d BS 4607-1 + A2.
- 2 Operating temperatures: -5 to 60°C
- 3 Construction:
 - a Material: PVCu
 - b Resistance to fire:
 - BS 4678 part 4: self-extinguishing, non-flame propagating
 - BS 476 part 7: Class 1Y.
 - c Finish Class: Corrosion resistance (non-corrosive) but not suitable for solvents and hydrocarbons.
 - d Resistance to compression: Not suitable
 - e BS4678: Resistance to impact
 - Round section High Medium Duty
 - Oval section: Light duty.
 - f Jointing: screwed ends.
- 4 Electrical characteristics: Non-conductive, but circuits within PVC conduits to incorporate protective conductors
- 5 Suitable for bending
- 6 Dimensions:
 - a Standard Sizes: Round section High Impact:

Outside Diameter	Inside Diameter	Wall thickness
mm	mm	mm
20	16.4	1.8
25	21.2	1.9
32	27	2.5
38	33	2.5
50	43.8	3.1
Oval section:		
Length x Width	Cross section area	Wall thickness
mm	mm ²	mm
13x8	60	0.9
16x10	103	0.9
22.5x11	172	0.9
29x11	225	1.0
29x16	336	1.0
23x14	238	0.8

C

Fittings & Accessories:

- 1 Fittings: Couplers, bends and tee to match conduit grade and finish:
 - a Use solid couplers to join lengths of conduit
 - b Solvent weld type: Use adhesive in accordance with manufacturer's instructions

- 2 Accessories: Terminal, loop in, extension, back outlet, angle boxes etc:
 - a Material: PVC with provision for the fitting of a brass earth terminal.
 - b Ensure fittings are same class and finish as associated conduit system
 - c Supply covers for circular or adaptable boxes in the same material and finish as boxes
 - d Bushes, locknuts and lock rings: PVC
 - e Limit number of entry holes within loop-in boxes to four.
- 3 Adaptable box: PVC with lids secured by mushroom head screws:
 - a minimum size – 75 x75x 50mm.

Y60.2.6 FLEXIBLE CONDUIT – METALLIC

- A Stainless steel or galvanised steel, helically wound, flexible conduit. Provide coatings where indicated for the following applications or where indicated on the drawings and specification section B and to suit the environment in which they are to be installed:
- a Galvanised Steel:

• Uncoated: • PVC: • Nylon: • LFH: • PVC Liquid Tight:	- Underfloor wiring in commercial buildings - General factory wiring and connections to machines - High temperature /solvent resistant and abrasion resistant. - Public and commercial buildings and tunnels - Machine tools or outdoor installations (UV resistant black)
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 - b Stainless Steel:

• Uncoated: • PVC Liquid Tight	- instrumentation, security systems - Food processing or outdoor where high corrosion resistance is required
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- B Manufacturers:
- 1 Flexicon
 - 2 Adaptaflex
 - 3 Kopex
 - 4 Hellermann Tyton
 - 5 Legrand
- C Construction:
- 1 Standards:
 - a Conduit & fittings: BS EN 61386 -23
 - 2 Properties: As indicated in table below. IP rating depends upon fitting selection
 - a Fire Hazard:
 - Low Fire Hazard
 - Self-extinguishing
 - Halogen free
 - b Abrasion resistance: high

	IP Rating	Comp Strength (20mm dia)	Pull-off Strength (20mm dia)	Min Bend radius (20mm dia)	Temp Range
		kg/100mm	kg	mm	°C
GS Uncoated	IP40	350	120	45	-100 to +300
GS PVC coated	IP54, IP65	350	120	45	-15 to +70
GS Nylon coated	IP54, IP65	350	120	45	-40 to +120
GS LFH coated	IP54, IP65	350	120	45	-25 to +90
GS PVC liquid tight	IP66, IP67, IP68, IP69K	400	130	65	-20 to +105
Stainless Steel	IP40	400	170	45	-100 to 600
Stainless Steel PVC coated liquid tight	IP66, IP67, IP68, IP69K	400	130	65	-20 to +105

D Dimensions: Nominal sizes: 20,25,32,40,50,63mm.

E Fittings: Use manufacturer's standard suitable for the IP rating required:

- 1 Galvanised steel:
 - a Uncoated: Nickel Plated Brass
 - b PVC coated: Nickel Plated Brass
 - c Nylon Coated: Nickel Plated Brass
 - d LFH coated: Nickel Plated Brass
 - e PVC Liquid Tight; Nickel Plated Brass or stainless-steel fittings
- 2 Stainless Steel: External Thread stainless steel with nylon seal.

Y60.2.7 FLEXIBLE CONDUIT NON- METALLIC

A Nylon, PVC or polypropylene flame retardant corrugated flexible conduit. Provide to suit application or where indicated on the drawings and specification section B and to suit the environment in which they are to be installed:

- a Nylon: LFH PA6, Heavy weight:

buildings

Machinery connections within public

Highly resistant to solvents and oils
UL 94 V2 flame retardancy
- b Polypropylene: Heavyweight polypropylene, Colour black or grey: Use where buried in concrete /plaster. Acid resisting locations.
- c uPVC: corrugated pliable conduit standard weight.
Colour, black, grey or white:

Only use with CA approval for static connections in non-public buildings.

B Manufacturers: Provide conduits from one of the following subject to complying with the requirements:

- 1 Flexicon

- 2 Adaptaflex
- 3 Kopex
- 4 Hellermann Tyton
- 5 Legrand

C Construction:

- 1 Standards:
 - a Conduit & fittings: BS EN 61386 -23
- 2 Properties: As indicated in table below. IP rating depends upon fitting selection
 - a Fire Hazard:
 - Low Fire Hazard
 - Self-extinguishing
 - Halogen free
 - b Abrasion resistance: high

	IP Rating	Comp Strength (20mm dia)	Pull-off Strength (20mm dia)	Min Bend radius (20mm dia)	Temp Range	EMC screening at 1MHz
		kg/100mm	kg	mm	°C	
Nylon LFH PA6 Heavy weight	IP66, IP67, P68, IP69K	120	70		-40 to +120	
Polypropylene, heavy weight	IP40, IP66, IP67, IP68	100	40		-40 to +120	
uPVC	IP40, IP66, IP67	150	30		-5 to +70	

D Dimensions: Nominal sizes: 21,28,34,42,54,67mm (not all sizes are available in all materials).

E Fittings: Use manufacturer's standard suitable for the IP rating required.

Y60.2.8 INTUMESCENT CONDUIT

A A conduit system designed to provide a fire rated cable management system for passing cables through fire rated walls and floors. Primarily used for connecting to non-metallic conduit situations. Conduit may be filled with cables or left empty (open ends sealed with intumescent sealant) for future cable installations.

B Manufacturers: Subject to compliance with the requirements conduits may be selected from one of the following or approved equivalent:

- 1 PFC Corofil
- 2 Fischer
- 3 Envirograf Fireoblock
- 4 Polypipe

C Conduits to comply with the following and should be installed strictly in accordance with manufacturer's instructions:

- 1 Testing: Products to be fire tested:
 - a Fire tests:
 - BS 476 pt 20
 - BS EN 1366-3.
- 2 Properties:
 - a Material: Extruded graphite polymer
 - b Fire properties up to:

- Integrity: 2 hours
 - Insulation: 2 hours
- 3 Dimensions: 20mm,25mm,32mm.

Y60.2.9 CONDUIT SUPPORTS AND FIXINGS

- A Provide proprietary suspension systems comprising channel sections with return lips and compatible fixing accessories made of material to BS EN 10162 and BS EN 10210.
- B Ensure support components for Class 4 conduit have the same finishing method as the conduit carried out after manufacture. Ensure components in direct contact with conduit match profile of conduit.
- C Ensure all steel components such as studding, bolts and steel screws, bolts, nuts and washers are either cadmium plated and passivated, or zinc electroplated to BS 7371 after manufacture. Do not use metal fixing components likely to deteriorate and/or cause damage through electrolytic action.

Y60.2.10 TRUNKING GENERAL

- A Application: Use trunking to avoid multiple parallel conduit runs.
- B Trunking systems are to be suitable for the environment into which they are to be installed. Use the most appropriate materials /finishes for the environment and degree of pollution into which they are to be located:
- 1 Manufacturing Standard: BS EN 61537
 - 2 Design to allow for any additional forces that could be applied to the support systems such as wind, snow in addition to the weight of the cables
 - 3 Support systems: Design supports to suit the imposed loads and the nature and spacing of the supporting structure to which the supports are attached.
- C Provide resistance to corrosion by selecting suitable materials and finishes as indicated below for various environments. Use these or project specific requirements if indicated on the drawings or within specification section B. When using stainless steel check, the suitability of the particular type (304L or 316L) for the nature of the airborne pollution:
- 1 **Internal, normal heated environment:** Corrosion Class C1- very low (BS EN ISO 12944-2)
 - a Mild steel Electro galvanising after manufacture: BS EN ISO 2081
 - 2 **Internal, non- heated areas with low levels of humidity and pollution:** Corrosion Class C2- Low (BS EN ISO 12944-2)
 - a Mild steel Pre-Galvanised: BS EN 10244-2
 - 3 **External installation in urban environment/ some Industrial pollution:** Corrosion Class C3/C4- average to high (BS EN ISO 12944-2)
 - a Mild steel Hot dip galvanised after manufacture: BS ISO 1461
 - 4 **Chemical industries, nitrate explosives, photography, high levels of humidity:** Corrosion Class C5-I- very high industrial (BS EN ISO 12944-2)
 - a Stainless steel; type 316L: BS EN 10088 Grade 1-4404
 - 5 **Marine, harsh or sulphurous environments, very high humidity:** Corrosion Class C5-M Very high marine (BS EN ISO 12944-2)
 - a Stainless steel: Type 316L: BS EN 10088 Grade 1-4404
 - 6 **Acid or alkaline environments, high humidity:** Corrosion Class C5-I- very high industrial (BS EN ISO 12944-2)
 - a Stainless steel: Type 304L: BS EN 10088 Grade 1-4301
 - 7 **Food production:**
 - a Stainless steel: Type304L: BS EN 10088 Grade 1-4301
 - 8 **Aesthetic appearance:** Colour powder coating: Use only where indicated. Powder coating to be of approved colour over hot dip galvanised finish.

Y60.2.11 METAL DISTRIBUTION TRUNKING

- A Cable distribution trunking comprising, mild or stainless-steel box with accessible lid to permit the installation of cables sheathed and non-sheathed. For non -sheathed applications comply with IEE wiring regulations and ensure that the cover can only be removed by means of a tool or deliberate action.
- B Trunking material and finish to be suitable for the environment into which it is to be installed. Refer to general clauses above and specification section B.
- C Trunking systems to be supplied complete with all necessary couplers, lids, accessories and fixings. Where indicated provide tamperproof lid fixings which are required for trunking conveying security cabling or where trunking systems are within reach of the general public. Suitable manufacturers:
- 1 Steel:
 - a Metsec
 - b Legrand
 - c Trench Ltd
 - 2 Stainless steel:
 - a Electrix
 - b Lasnek
- D IP rating standards: Trunking systems to provide the following minimum levels of protection to BS EN 60529:
- 1 Sheathed cables: IP30
 - 2 Non- sheathed cables: IP4X
 - 3 External: Weatherproof to IP65
- E Dimensions:

Width mm	50	75	100	150	225	300
Height mm	50	50	50	50		
		75	75	75	75	75
			100	100	100	100
				150	150	150
					225	
						300
Min Steel thickness mm	1.5	1.5	1.5	1.75	1.75	1.75

- F Construction: All standard rectangular section trunking shall be of the lipped type i.e. the sides to be flanged over or lipped along the opening over which the cover fits. Lids or cover plates for rectangular section trunking to be of similar gauge and finish as the trunking, with edges flanged over to overlap the sides of the trunking and complete with substantial means of attachment to the trunking.
- 1 Standards:
 - a Manufacturing Standard: BS EN 61537
 - b Construction: BS EN 50085-2-1;
 - c Steel: BS EN 10346
 - d Stainless steel: BS EN 10088.
 - 2 Material/Finish: to suit environment:
 - a Mild steel: Electro galvanising after manufacture, BS EN ISO 2081
 - b Mild Steel: Pre-galvanised, BS EN 10244-2
 - c Mild Steel: Hot dip galvanised, BS ISO 1461

- d Stainless steel: type 316L BS EN 10088 Grade 1-4404
 - e Stainless steel: Type 304L BS EN 1088 Grade 1-4031
 - f Powder coated: Epoxy power coated to approved colour over hot dip galvanised finish.
- 3 Compartments: Number as indicated on the drawings.

Y60.2.12 LIGHTING TRUNKING

- A A 50mm x50mm metal trunking systems with a clip in lid/cover strip system which can be cut to length to suit the lighting installation. Cover strip to prevent ingress of foreign materials, locate cabling in place and act as closure strips between luminaires. System to be complete with couplers providing earth continuity.
- B Construction:
- 1 Trunking body: as detailed for metal trunking systems
 - 2 Lids: Optional materials are as indicated below. Where not indicated on the drawings or section B of the specification provide as follows:
 - a Galvanised: For industrial type applications
 - b Plastic: cPVC white.
- C Maximum Loadings: The table below gives maximum acceptable deflections for a maximum 3m span. Provide additional supports at end span to limit deflection to that indicated.

Load	Deflection	
kg	Mid-span (mm)	End span (mm)
6	2.1	2.1
9	2.5	2.5
12	3.6	3.6
15	4.5	4.5

Y60.2.13 PVC DISTRIBUTION TRUNKING

- A Cable distribution trunking comprising, white or grey coloured PVCu box with accessible lid to permit the installation of cables sheathed and non-sheathed. For non -sheathed applications comply with IEE wiring regulations and ensure that the cover can only be removed by means of a tool or deliberate action.
- B For applications refer to general clauses above and specification section B.
- C Trunking systems to be supplied complete with all necessary couplers, lids, accessories and fixings. Where indicated provide tamperproof lid fixings which are required for trunking conveying security cabling or where trunking systems are within reach of the general public.
- D Manufacturers:
- 1 MK Electric - Ega Industrial trunking range
 - 2 Marshall Tufflex – Maxi Trunking range
 - 3 Schneider – TRK range
 - 4 <insert name>
- E IP rating standards: Trunking systems to provide the following minimum levels of protection to BS EN 60529:
- 1 Sheathed cables: IP30
 - 2 Non- sheathed cables: IP4X
 - 3 External: Weatherproof to IP65.

F Dimensions: Standard dimensions (not available from all manufacturers)

Width(mm)	50	75	100	150
Height (mm)	50	50	50	
		75	75	75
			100	100
				150

G Construction: All standard rectangular section trunking to be of the lipped type i.e. the sides to be flanged over or lipped along the opening over which the cover fits. Lids or cover plates for rectangular section trunking to be of similar gauge and finish as the trunking, with edges flanged over to overlap the sides of the trunking and complete with substantial means of attachment to the trunking:

- 1 Standards:
 - a Manufacturing Standard: BS 4678 part 4
 - b Impact resistance: Heavy Classification
 - c CE marked.
- 2 Compartments: Number as indicated on the drawings
- 3 Chemical Resistance:
 - a Mineral Acids; Excellent
 - b Detergents: Excellent
 - c Alcohols: avoid use in solvent or hydrocarbon atmospheres.
- 4 Fittings: Use fittings from same manufacturer as trunking. Use 'snap-on' covers. Use trunking fittings and accessories suitable for jointing by solvent welding
- 5 Fixing cables: Use proprietary cable retaining clips at 500mm maximum intervals on trunking that exceeds 1.8 m in length. Where junctions occur ensure first clip is not more than 300mm from junctions.

Y60.2.14 STEEL PERIMETER TRUNKING SYSTEMS

A A strong and rigid heavy-duty wall mounted trunking system with single or multi-compartment trunking complete with power, data and communication cable ways suitable for the installation of power, data and communications socket outlets on the fascia.

B Manufacturers: Select from one of the following or approved equivalent:

- 1 Legrand
- 2 Marshall-Tufflex
- 3 Armorduct

C Description: Rectangular steel box section with removable covers and all necessary accessories to form a complete system. Provide sizes as indicated in the drawings or section B of this specification:

- 1 Dado applications: Typical dimensions:
 - a sizes 110x63mm, 130x63mm, 170x63mm
 - b sizes: 150x50mm, 175x50mm, 200x50mm.
- 2 Skirting applications:
 - a Sizes: 170x63mm
 - b Sizes: 150x50, 200x50mm.

D Construction: Pre-galvanised steel construction with powder coated four finish:

- 1 Body: Hot dipped galvanised sheet steel to following standards:
 - a BS EN10346
 - b BS EN 50085-1, BS EN 50085-2-1

- c BS4678 Part 1 - Class 3 Heavy Protection against Corrosion.
 - 2 Lid: Hot dip/Electro coated steel: BS EN 10152; BS EN 10130:1991
 - 3 No. of compartments: As indicated on the drawings
 - 4 CAT 6 compliant design.
- E Body Finish: Provide as indicated on the drawings or section B of this specification:
- a Self-colour galvanised sheet steel
 - b Epoxy powder coat in white RAL 9010 (LSF)
 - c Epoxy powder coat in approved colour.
- F Lid Finish: Provide as indicated on the drawings or section B of this specification:
- a Self-colour galvanised sheet steel.
 - b Epoxy powder coat in white RAL 9010
 - c Epoxy powder coat in approved colour
 - d 1.2mm stainless steel: Type 304:
 - Mill finish 2A: bright, annealed
 - Mill finish 2B: Satin

Y60.2.15 PVC PERIMETER TRUNKING

- A A lightweight rigid medium duty PVCu wall mounted trunking system with single or multi-compartment trunking complete with power, data and communication cable ways suitable for the installation of power , data and communications socket outlets on the fascia.
- B Manufacturers: Select from one of the following or approved equivalent:
- 1 MK Electric – Prestige 3D
 - 2 Marshall-Tufflex
- C Description: Rectangular white PVCu box section with removable covers and all necessary accessories to form a complete system. Provide sizes as indicated in the drawings or section B of this specification.
- 1 Typical Dimensions: Following sizes are typical comply with sizes indicated on the drawings if different.
 - a Dado applications: Typical dimensions:
 - Sizes: 170x 57mm, 155 x55mm
 - b Skirting applications:
 - Sizes: 170x 57mm, 155 x 55mm
 - 2 Construction: Extruded PVCu white finish to following standards:
 - a Trunking system requirements: BS EN 50085-1, and BS EN 50085-2-1; BS 4678-4
 - b Electrical Accessories: BS 4662
 - c Fittings and components: BS4607 Part 1
 - d Fire Resistance: BS 476 Part 7 class 1Y, BS EN 50085-1 non-flame propagating
 - e Impact Resistance: BS 4678 Medium Duty.
 - 3 CAT 6 compliant design
 - 4 Steel screening divider
 - 5 50mm power data separation BS EN 50174-2
 - 6 No. of compartments: As indicated on the drawings (where not indicated provide 3)
 - 7 Covers: Clip on type
 - 8 Finish: paintable surface if alternative colour required.
 - 9 Chemical resistance: non-corrosive.
- D Fittings: Use fittings from same manufacturer as trunking. Use 'snap-on' covers unless screwed type indicated on the drawings.

Y60.2.16 UNDERFLOOR TRUNKING - FLUSH LID – NO SERVICE OUTLETS

- A Application: For use in screeded floors where a concealed wiring system is required with the floor finish fitted over or within the flush lid . The entire trunking is fixed flush with the finished floor and is used for

continuous long lengths of cable runs. Service outlets are not available for these systems. Supply and install the complete system strictly in accordance with the manufacturer's instructions:

- 1 Flush installation: Trunking sits flush with the finished floor surface and provides access to the complete wiring way via a continuous removable lid. Lid can be of the following types depending upon the application:
 - a Commercial applications: 2.5mm thick steel
 - b Industrial applications: 6.5mm thick steel chequer plate
- 2 Recessed installation: Lid forms a recess to take finished floor covering.
 - a Commercial applications: 2.5mm thick recessed 3.5mm to allow for floor finish.

B Manufacturers; Select from one of the following or approved equivalent:

- 1 Legrand
- 2 Marshall- Tufflex
- 3 Schneider Electric
- 4 Armorduct

C Select trunking to suit the depth of screed, floor finish and the number of separate compartments required or as indicated on the drawings. Provide sizes as indicated on the drawings or comply with the following typical nominal dimensions:

- 1 Commercial Applications 2.5mm lid:
 - a 2 compartment: 100 x 50mm
 - b 3 compartment: 150 x 75mm
 - c 4 compartment: 300 x 100mm.
- 2 Industrial applications: 6.5mm lid:
 - a 2 compartment: 100 x 50mm
 - b 3 compartment: 150 x 75mm
 - c 4 compartment: 300 x 100mm.

D Construction: Adjustable height metal tray with removable access lids supplied complete with all necessary connectors and screws. Service outlet boxes to be provided as indicated on the drawings:

- 1 Body & Lid:
 - a Pre-galvanised sheet steel to BS EN 10346
 - Body: 1.5mm
 - Lid: 2.5mm or 6.5mm
 - Dividers: 1.0mm.
 - b BS EN 50085-1, BS EN 50085-2-2.
 - c Classifications:
 - Resistance to impact: 2.0J
 - Minimum temperature: -5°C
 - Maximum temperature: +60°C
 - Degree of protection: IP 20.
 - d Resistance to vertical load: Applied over a small surface area:
 - 2.5mm thick: 750N
 - 6.5mm thick: 5000N.
- 2 Compartments: Provide number as indicated on the drawings or to suit the segregation required between power, data and comms systems
- 3 CAT 6 compliant design.

E Standard components:

- 1 Junction boxes: Provide direct access to cables at all trunking intersections
- 2 Levelling support: Fixing bracket and levelling support for trunking
- 3 Vertical riser boxes: To provide draw-in facilities for a change of plane or direction of the trunking and connection to skirting trunking or wall mounted distribution boards.

Y60.2.17 BURIED "IN SCREED" FLOOR TRUNKING

- A Application: For use in screeded floors where a concealed wiring system is required. A minimum of 30mm screed is required above the trunking. Note that service outlets can be incorporated where indicated on the drawings.
- B Manufacturers; Select from one of the following or approved equivalent:
- 1 Legrand
 - 2 Marshall- Tufflex
 - 3 Schneider Electric
 - 4 MK Electric
 - 5 Britmac
 - 6 Armorduct
- C Select trunking to suit the depth of screed, floor finish and the number of separate compartments required or as indicated on the drawings. Provide sizes as indicated on the drawings or comply with the following typical nominal dimensions:
- 1 1 Compartment: 100x25, 100 x38mm
 - 2 2 Compartment: 150 x 25mm, 150 x 38mm
 - 3 3 Compartment:
 - a 225 x25mm, 225 x 38mm
 - b 250x25mm, 250x38mm
 - c 275x25mm, 275 x 38mm
 - d 300x25mm, 300x38mm.
- D Construction: Adjustable height metal tray with removable access lids supplied complete with all necessary connectors and screws. Service outlet boxes to be provided as indicated on the drawings:
- 1 Body & Lid:
 - a Pre-galvanised sheet steel to BS EN 10346
 - Body: 1.5mm
 - Lid: 2.5mm
 - Dividers: 1.0mm
 - b BS EN 50085-1, BS EN 50085-2-2
 - c Classifications:
 - Resistance to impact: 2.0J
 - Minimum temperature: -5°C
 - Maximum temperature: +60°C
 - Degree of protection: IP 20.
 - 2 Compartments: Provide number as indicated on the drawings or to suit the segregation required between power, data and comms systems
 - 3 CAT 6 compliant design.
- E Standard components: Junction boxes and service outlet boxes to be supplied and installed to suit the minimum height of the screed:
- 1 Junction boxes: Provide direct access to cables at all trunking intersections
 - 2 Levelling support: Fixing bracket and levelling support for trunking
 - 3 Service boxes: Supply and install to suit the floor finish complete with support plate, lid, trim and power and data /comms socket outlet provisions as indicated on the drawings.

Y60.2.18 RAISED FLOOR TRUNKING SYSTEMS

- A Application: For use in raised floor installations where access is required to the complete wiring system and flexibility to move outlet points to suit various workstation configurations is possible. Usually a number of parallel trunkings are run side by side to provide the segregated circuits and flexible conduits are glanded off to outlets as required.
- B Manufacturers: Select from one of the following or approved equivalent:

- 1 Britmac
 - 2 Marshall- Tufflex
 - 3 Schneider Electric
 - 4 MK Electric.
- C Select trunking to suit the depth of floor cavity, floor finish and the number of separate compartments required or as indicated on the drawings. Provide sizes as indicated on the drawings or comply with the following typical nominal dimensions but check availability with manufacturer:
- 1 1 Compartment: 100 x 40mm
 - 2 2 Compartment: 200 x 40mm
 - 3 3 Compartment: 300 x 40mm.
- D Construction: metal tray with removable access lids supplied complete with all necessary connectors and screws. Service outlet boxes to be provided as indicated on the drawings.
- 1 Body & Lid: 1.5mm Pre-galvanised sheet steel to BS EN 10346
 - 2 Service boxes: To be supplied to suit the floor void depth:
 - a BS EN 50085-1, BS EN 50085-2-2
 - b Classifications:
 - Resistance to impact: 2.0J
 - Minimum temperature: -5°C
 - Maximum temperature: +60°C
 - Degree of protection: IP 20.
 - 3 CAT 6 compliant design.
- E Standard components: Junction boxes and service outlet boxes to be supplied and installed to suit the minimum height of the screed:
- 1 Junction boxes: Provide direct access to cables at all trunking intersections
 - 2 Levelling support: Fixing bracket and levelling support for trunking
 - 3 Service boxes: Supply and install to suit the floor finish complete with support plate, lid, trim and power and data /comms socket outlet provisions as indicated on the drawings.

Y60.2.19 SERVICE OUTLET BOXES RAISED ACCESS FLOORS

- A Raised Access Floor service box: To provide a housing for power, data and telecom socket outlets service workstations within a cavity floor installation. Provide boxes with dividers to configure the number of compartments. Boxes to be complete with reversible self-closing lid, snap in retainer guides and suitable for heavy duty steel galvanised conduit (BS EN 61386-23).
- B Manufacturers: Subject to compliance with the requirements provide raised access floor outlet boxes from one of the following manufacturers or approved equivalent: Ensure that boxes are, adjustable in height, compatible with the underfloor trunking systems and with the raised floor installation:
- 1 Legrand
 - 2 MK Electric
 - 3 Schneider
 - 4 Cableduct
- C Construction:
- 1 Typical configuration and dimensions: Actual dimensions will vary between manufacturers.
 - a 1 compartment: 165x203 x 85mm deep
 - b 2 compartment: 290x230 x 75mm, 85mm or 110mm deep
 - c 3 compartment: 360 x230 x75mm, 85mm or 110mm deep
 - d 4 compartment: 360x230x 75mm, 85mm or 110mm deep.
 - 2 Standards: Designed and manufactured to:
 - a BS EN 61534-22:
 - b BS EN 60670-1:
 - c BS EN 60670-23:

- d BS EN 50085-1:
- e BS EN 50085-2-2:
- 3 Materials:
 - a Mounting frame and box: 0.9mm galvanised steel
 - b Lid: fire retardant, halogen free ABS reinforced with galvanised steel plate
 - c Lid recess: 6mm unless indicated otherwise.
- 4 Box Configuration:
 - a Dividers to create number of compartments
 - b 2 earth fixing points
 - c Entries: 2 x 20mm and 2 x 25mm for each compartment, fitted with grommets
 - d Sub-steel frame for heavy traffic areas
 - e Cut out in lid for floor finish up to 6mm or greater where required
 - f RCD option if indicated on the drawings
 - g Reversible self-closing lid.
- 5 Plate configurations: Provide Boxes with power outlets, data outlets and voice outlets as indicated on the drawings:
 - a Blank plate
 - b 2 gang 13A SSO
 - c 3 gang unswitched SO
 - d 2 gang RCD SO
 - e 4 x Data/Telecom plates
 - f 6 x Data/telecom plates.

Y60.2.20 SERVICE OUTLET BOXES FOR SCREEDED FLOORS

- A Screeded Floor service box: To provide a housing for power, data and telecom socket outlets for flush mounting within a solid floor screed. Provide boxes with dividers to configure the number of compartments. Boxes to be complete with reversible self-closing lid, snap in retainer guides and suitable for heavy duty steel galvanised conduit (BS EN 61386-23).
- B Manufacturers: Subject to compliance with the requirements provide flush floor mounted service outlet boxes from one of the following manufacturers or approved equivalent: Ensure that boxes are, adjustable in height, compatible with the underfloor trunking systems and with the depth of floor screed:
 - 1 Legrand
 - 2 MK Electric
 - 3 Schneider
 - 4 Cableduct
- C Construction:
 - 1 Typical configuration and dimensions: Actual dimensions will vary from manufacturer to manufacturer:
 - a 1 compartment: 165x203 x 85mm deep
 - b 2 compartment: 290x230 x 75mm, 85mm or 110mm deep
 - c 3 compartment: 360 x230 x75mm, 85mm or 110mm deep
 - d 4 compartment: 360x230x 75mm, 85mm or 110mm deep
 - 2 Construction and facilities:
 - a Materials:
 - Mounting frame and box: 0.9mm galvanised steel
 - Lid: fire retardant, halogen free ABS reinforced with galvanised steel plate
 - Lid recess: 6mm unless indicated otherwise.
 - 3 Configuration:
 - a Dividers to create a number of compartments
 - b 2 earth fixing points
 - c Entries: Type depends on floor trunking system:
 - Flush screed trunking
 - In screed trunking
 - d Cut out in lid for floor finish up to 6mm or greater where required

- e RCD option if indicated on the drawings
 - f Reversible self-closing lid.
- 4 Plate configurations: Provide Boxes with power outlets, data outlets and voice outlets as indicated on the drawings.
 - a Blank plate
 - b 2 gang 13A SSO
 - c 3 gang unswitched SO
 - d 2 gang RCD SO
 - e 4 x Data/Telecom plates
 - f 6 x Data/telecom plates.
- D Provide floor grommets in conjunction with slab mounted floor boxes with finish as follows unless indicated otherwise:
 - 1 Back of House: Plastic
 - 2 Office Areas: Plastic
 - 3 Public areas: brushed stainless steel
- E Floor outlet boxes for the audio-visual specialist work shall be type as indicated on the drawings and schedules.

Y60.2.21 SERVICE POLES & POSTS

- A Power Poles: Stand between the floor and ceiling and can be integrated as part of a co-ordinated cable Management system. Secured to the floor by a load plate with a jacking assembly to allow adjustment for varying ceiling heights as well as to secure it to the ceiling. Outlet boxes can be located at virtually any height on the poles, so power and data points, light switches and accessory housings can be positioned at the optimum level for efficient operation.
- B Power Posts: Stand neatly on the floor and accept cables from below. Fit under desks, and a single unit will provide up to twelve outlets for any combination of power and data points, light switches and accessory housings.
- C Manufacturers; Select from one of the following or approved equivalent:
 - 1 Britmac
 - 2 Marshall- Tufflex
 - 3 Schneider Electric
 - 4 MK Electric.
- D Construction:
 - 1 Body:
 - a Natural anodised Aluminium AW 6060
 - b White powder coated Aluminium AW 6060
 - 2 Standards: BS EN 573 and BS EN 755
 - 3 Compartments: 2, 3 or 4 as indicated on the drawings
 - 4 Covers:
 - a PVCu in white
 - b PVCu charcoal.
 - 5 Fire resistance: Testing in accordance with:
 - a Self-extinguishing non-flame propagating in accordance with BS 4678 Part 4.
 - b Extrusion BS476part 7: Class 1Y.
 - c Moulding material: IEC 695-2-1 at a severity of 650°C.
 - 6 IEE Wiring Regulations
 - 7 BS 7671: 2008 (IET wiring regulations)
 - 8 Quality Assurance: BS EN ISO 9001.
- E Dimensions:
 - 1 Power post: 100x100x 650mm high

2 Power Pole: 100 x 100 x 3600mm high (maximum).

- F Provide service poles complete with associated conduit or trunking fittings. Maintain continuity and segregation of circuits throughout.

Y60.2.22 TRUNKING SUPPORTS AND FIXINGS

- A Provide proprietary floor/wall support brackets by the trunking or tray manufacturer and fix strictly in accordance with the manufacturer's instructions.
- B For suspended systems: Provide a suspension system comprising channel sections with return lips and compatible fixing accessories made of material to BS EN 10162, BS EN 10210 and/or slotted angles.

Y60.2.23 SOURCE QUALITY CONTROL

- A Perform design and production tests according to manufacturer's guidance and recommendations.

Y60.3 PART 3 – EXECUTION

Y60.3.1 CONTAINMENT SYSTEMS GENERAL

- A Support all cables throughout their length using conduit; or trunking and enclosures; as indicated on the drawings / schedules. Use conduit or trunking systems suitable for the applications and the environment into which they are to be installed.
- B Comply strictly with the manufacturer's installation requirements.
- C Fire Barriers: Comply with the requirements of BS7671 wherever conduits or trunking passes through a fire compartment (wall, floor or ceiling). Ensure that the fire rating of the walls or floors is maintained. For fire stopping details see section Y90.
- D Where different containment systems connect with each other comply 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

- E Flexible Conduit:
- 1 Use flexible conduit for final connections to motors, other equipment subject to vibration or adjustment and to thermostats, motorised valves and similar items mounted in pipelines or ducts
 - 2 Use sufficient length between equipment and circular through box at end of conduit run (minimum 450mm) to allow necessary full range of withdrawal, adjustment or movement
 - 3 Use solid type adapters to terminate flexible conduit
 - 4 Use PVC covered flexible conduit where installed externally, exposed to weather or in any position where ingress of moisture or condensation may occur
 - 5 Refer also to section B of this specification.
- F Use flexible joints when crossing building expansion joints.
- G Clean inside of conduits and trunking with swabs immediately before wiring.
- H Inspect all components and remove any foreign matter, fit temporary plugs to open ends of conduit and trunking to prevent ingress of water and solid material.

Y60.3.2 CONDUIT & TRUNKING INSTALLATION GENERALLY

- A Support conduit in accordance with the requirements of BS7671 and associated Guidance Notes.
- B Ensure conduit is not under mechanical stress. Fix conduit boxes independently of conduit. Make allowance for any additional mechanical loading supported by conduit boxes.
- C Where protection is specified as IP44 or greater ensure fixings of conduit boxes are suitable to maintain degree of protection.
- D Use following methods of fixing conduit:

Location	Type of fixing
Floor screeds	Saddles or crampets
Buried in plaster or render	Crampets or saddles
Above false ceilings	Saddles
Surface	Saddles

- E For metallic systems ensure entire system is electrically continuous, to BS7671.
- F Use materials clean and free from defects, rust, scale and oil. Obtain prior permission in writing for use of materials subject to remedial work before erection. Repair any damage caused by threading, bending or erection by painting with zinc rich paint before any rust occurs.
- G Ensure length of thread on conduit matches that in conduit couplers, fittings or equipment with no thread exposed after erection except at running couplers.
- H Appearance: Arrange conduit, trunking and ducting to present neat appearance, parallel with other service runs and lines of building construction, except where in screed or in-situ concrete. Ensure plumb vertical runs.
- I Cable Installation: Install cable in conduit, trunking or equipment enclosures only when completely erected throughout its length.
- J Layout:
- 1 Ensure the maximum circuit lengths and groupings of cables indicated are not exceeded
 - 2 Where dimensions are not indicated select trunking and conduit sizes in accordance with BS7671.
- K Spacing: Install conduit, trunking and equipment clear of other services. Measure distance from external surface of any thermal insulation. Notify instances where minimum clearance cannot be achieved, and bond items concerned. Minimum general spacing between conduits, trunking, equipment and:
- 1 Insulated steam services - 300mm
 - 2 Other services excluding steam - 150mm
 - 3 Above central heating radiators - 1000mm.
- L Ensure separation is in accordance with the requirements of BS7671 and associated Guidance Notes.
- M Access: Arrange trunking to allow access to wiring. Locate covers on top or sides of trunking if practicable. Arrange access so covers are on a continuous face and cables can be laid in throughout the length of the trunking. Notify where either condition cannot be achieved.
- N Do not:
- 1 use conduit less than 20mm diameter
 - 2 leave ends of conduits open during building operations
 - 3 use more than two right-angled bends, or longer than a 10m length of conduit between draw-in boxes.
 - 4 cross conduits in multiple conduit installations
 - 5 use conduit/trunking and accessories damaged by weather or other hazards
 - 6 use previously used conduit/trunking
- O Draw in cables in a careful and workmanlike manner. "Comb" cables as drawing-in proceeds and lay the neutral and protective conductors of each circuit with each phase cable of that circuit.
- P Where a surface conduit turns through a wall install a back-outlet box.
- Q Support each bend set, adaptable box, and conduit box, at 150mm (maximum) on each side, equally spaced.
- R In areas where there is danger of condensation, fill boxes with a moisture repelling compound.
- S Ensure all conduit work is drained, cleared, and swabbed before wiring is carried out.
- T Ensure conduit installations in flameproof areas use flameproof boxes and glands.

Y60.3.3 SCREWED STEEL CONDUIT INSTALLATION

- A Rigid metal conduit is fixed in the normal way with saddles or clips. The distance between saddles should not exceed that stated in the following table, or less in hot temperatures.

Metallic Conduit support spacing

Nominal Conduit Size	Maximum Distance between supports (m)	
(mm)	Horizontal	Vertical
≤ 16	0.75	1.0
> 16 but ≤ 25	1.75	2.0
> 25 but ≤ 40	2.0	2.25
> 40	2.25	2.5

- B Saddles:

- 1 Black enamel conduit: Ensure Class 2 protective areas have spacer bar type saddles with 3mm clearance between the conduit and fixing surface
- 2 Galvanised conduit: Ensure Class 4 protection areas have distance spacing type saddles with 12mm clearance between the conduit and fixing surface. Ensure brass fixing screws are used in Class 4 areas.

- C Conduit Boxes:

- 1 Use circular malleable iron for all draw-in boxes, lighting points, angle boxes, tee boxes, and any junction up to four conduits
- 2 In all other cases use adaptable boxes of the appropriate protective finish
- 3 Ensure all boxes, have heavy steel covers fixed with brass screws, except where covered with a direct mounting accessory or fitting
- 4 Ensure covers are oversized where used as flush inspection points and with break joint rings at luminaire and ceiling switch positions
- 5 Ensure conduit boxes, with the exception of loop-in boxes, are spout entry, standard or deep pattern.
- 6 Ensure loop-in boxes are of the non-screwed entry type
- 7 Ensure conduit boxes in Class 4 protection areas are hot dip galvanised finish.

- D Adaptable Boxes:

- 1 Ensure fittings comply to the relevant Standards and are made of malleable iron or heavy-duty steel with welded joints and tapped lugs to receive the cover screws
- 2 Ensure boxes have the same protective coating as the conduit installation
- 3 Where used in a Class 4 installation, in exterior locations, or in areas of continual dampness, ensure that adaptable boxes have external lugs and a waterproofing seal between the box and the cover. In other Class 4 areas external lugs are not required
- 4 Ensure that where provided as junction boxes with permissible cable joints, the adaptable boxes are of adequate size to receive a din rail mounted heat resisting terminal block capable of withstanding the same temperatures as the cable insulation
- 5 Allow for cable sweeps and neat connections
- 6 Install the terminal blocks securely fixed to the box, using sealing washers in exterior locations or in areas of continual dampness
- 7 Where necessary, provide adaptable boxes with earthed barriers to segregate services
- 8 Provide overlap lids on flush installations.

- E Bushes:

- 1 Use only brass, male type, long threaded bushes where loop-in and non-screwed entries are provided. Do not use lock nuts and ring bushes

- 2 Earthing Terminals: Provide earthing terminals securely fixed to the box on all equipment boxes, conduit accessories and adaptable boxes to which cables or flexible conduits are fitted, or to boxes upon which accessories or equipment are mounted.

F Serrated Washers:

- 1 Use spring metal, female type.

G Conduit Installation: Quality:

- 1 Cut conduit clean and square with axis. Remove any burrs prior to erection
- 2 Site form 90°bends in conduit wherever practical or use circular or adaptable boxes
- 3 Construct bends and sets cold with a bending machine. Do not apply heat when forming sets or bends
- 4 Use bending tools complying with British Standards appropriate to conduit material
- 5 Ensure no indentation or reduction in cross sectional area occurs during installation
- 6 Use correct tools to assemble conduit. Ensure no tool marks or damage to components occurs.
- 7 Install inspection boxes in accessible positions giving due regard to switch and socket positions and any aesthetic requirements
- 8 Where conduits are connected to trunking, metallic boxes, panels, switchgear, or any item not having a tapped entry (or a tapped entry of 6mm or less), make the connections by long threaded male brass bushes with a coupling and serrated spring washer after removing the paint with a purpose made tool.
- 9 Tighten bushes with a tool specifically designed for that purpose - do not use pliers or toothed wrenches
- 10 Use locknuts with running couplings in Class 2 areas
- 11 During building operations plug and coat ends with petroleum jelly. Use only screwed caps or shaped plugs. Similarly protect conduit entries to all boxes by shaped plugs
- 12 Ensure all screwed connections are metal and watertight. Ensure in all cases conduit is screwed firmly into fittings, full use being made of the total length of thread. Where runners or similar type threaded connections are essential, heavy gauge hexagonal locknuts must be fitted and fully tightened. The ends of fittings, sockets, etc. in such cases to be machine finished to permit accurate contact and alignment
- 13 Make joints between conduits and accessories or equipment not having threaded spout entries by means of flanged couplings and hexagonal smooth bore male brass bushes. Ensure the bore of the bush to be not less than that of the conduit with which it is connected. Ensure clearance holes in accessories and equipment are accurately drilled and of correct size to accept the hexagonal bush.

H Conduit Installation:

- 1 Provide Draw-in boxes or through boxes at intervals of not more than 10m in straight runs of conduit and after not more than two such bends or changes in direction
- 2 Ensure conduits butt inside couplers
- 3 Use lubricant when cutting threads
- 4 Use minimum number of running couplings:
 - a For running couplings in Class 2 conduit, use coupler and locknut. Paint exposed thread with zinc rich paint
 - b For running couplings in Class 4 conduit, use three-piece conduit unions.

Y60.3.4 NON-METALLIC CONDUIT INSTALLATION

- A Comply with manufacturer's instructions for bending, setting and jointing of conduit. Use plastic conduit only where indicated. Do not install conduit when ambient working temperature is or will be below -5°C or above 60°C.
- B PVC round conduit is fixed in the normal way with saddles or clips. The distance between saddles should not exceed that stated in the following table, or less in hot temperatures.

Non-metallic conduit support spacing

Nominal Conduit Size (mm)	Maximum Distance between supports (m)	
	Horizontal	Vertical
≤ 16	0.75	1.0
> 16 but ≤ 25	1.5	1.75
> 25 but ≤ 40	1.75	2.0
> 40	2.0	2.0

- C Use solvents recommended by manufacturer of conduit when using solvent welded joints and ensure spigots enter full depth of sockets. Hold joints rigid and in position until weld sets. Remove excess solvent before surface damage occurs.
- D Use slip joints as necessary, but not exceeding 6 metres on straight lengths to allow for expansion and contraction over temperature variation as indicated.
- E Use semi-mastic adhesive where expansion joints are formed.
- F Where fitments do not have shaped or smooth conduit entries connect with male bushes and external couplings.
- G Ensure special care is taken to prevent mechanical damage or warping to conduit where mechanical loads are imposed on conduit system, e.g. light fittings.
- H It is recommended that all boxes be fixed first wherever practicable, using the two fixing holes provided in circular boxes. Lines may then be struck for the saddle run and the saddles should be fixed 225mm on either side of bend or boxes. The tubing may then be 'sprung' into the box spouts. It will be noted that the saddles are designed to be a sliding fit on the conduit, and it is important to see that all fixings should be sliding fits (see Expansion).
- I Expansion:
- 1 A rise in temperature of 25°C would cause an increase of 5mm in a 3 metre length of conduit. This may be ignored in flush work where the tube is bonded to the concrete or plaster
 - 2 In surface work, however, precautions must be taken or expansion will cause the tube to bow, although where bends and sets are close together these take up any expansion
 - 3 Where long straight runs occur in conditions of varying temperatures, care must be taken to overcome problems by using expansion couplers. These are couplers of double normal length with a shoulder formed 19mm from one end. Conduit is secured into this end of about 75mm long which is a sliding fit over the other conduit. The other conduit is inserted about 50mm into the coupler leaving it free to move 25mm in either direction, which is ample for even the greatest extremes of temperature
 - 4 For straight runs it is advisable to use an expansion coupling every 6 metres.
- J Adhesives: Use manufacturer's waterproof solvent weld for making watertight joints between PVC conduit, trunking and fittings.
- K Light fittings: When considering the use of totally enclosed lighting fittings, remember that the I.E.E. Wiring Regulations restrict the use of PVCu boxes to loads of 3 kg and a temperature of 60°C. When conditions in excess of these figures are anticipated, the use of either the heat resistant boxes or conduit boxes are required.
- L Bending: To bend circular conduit, insert the appropriate spring. The spring has an "eye" formed on one end, to which a cord should be attached in order to withdraw the spring. The bend is then made by hand or across the knee in accordance with standard practice.

Y60.3.5 UNDERGROUND CONDUIT INSTALLATION

- A For underground services refer to section P30 of this specification.

Y60.3.6 FLEXIBLE CONDUIT INSTALLATION

- A Install flexible conduits in accordance with the manufacturer's requirements and those of BS7671.
- B Use manufacturer's recommended tools and practices when working with flexible conduit.
- C Use flexible conduit generally for final connections to equipment in the following locations:
- 1 All equipment subject to vibration, including all electric motors
 - 2 All equipment which is subject to adjustment or which can be withdrawn for maintenance such as:
 - a Motorised valves, thermostats, controls, sensors, forming part of a piped or ductwork system, storage tanks; oil burners, etc.
- D Metallic Flexible Conduit: Ensure metallic flexible conduit complies with the relevant Standards and is of helical coiled steel with a waterproof sheath overall.
- 1 Ensure metal flexible conduit is not less than 300mm, and generally not longer than 1000mm, unless agreed with CA
 - 2 Terminate flexible conduits in proprietary manufactured couplings forming a waterproof and damp-proof connection.
- E Ensure non-metallic flexible conduits comply with the relevant Standards and with the requirements for metallic flexible conduits. Also use such conduits generally for final connections to equipment in the following locations:
- a Thermostats, control sensors etc. not forming part of a piped or ductwork system.
- F Do not use non-metallic flexible conduit for final connection to heat producing equipment.

Y60.3.7 STEEL TRUNKING INSTALLATION

- A Ensure trunking is independently fixed and supported from building fabric. Obtain approval for proposed fixings/supports.
- B Support trunking in accordance with the manufacturer's requirements and/or the requirements of the BS7671 and associated Guidance Notes.
- C Use two fixings minimum per standard length.
- D Comply with the following maximum support spacing for suspended trunking:

Steel trunking support spacing

Trunking size	Maximum Distance between supports (m)	
(mm x mm)	Horizontal	Vertical
Up to 25 x 25	0.75	1.0
Up to 50 x 25	1.25	1.5
Up to 50 x 50	1.75	2.0
Up to 100 x 100	3.0	3.0

- E Installation:

- 1 Cut trunking clean and square with axis, prepare ends and remove burrs and sharp edges. Ensure inside of trunking is free from anything liable to damage cables either during installation or after covers are fitted
- 2 When trunking is held in a vice, ensure surfaces remain undamaged and components are not warped.
- 3 Avoid tool marking or damage to trunking system components
- 4 Do not site fabricate trunking tees, bends, flanges and other accessories. Use only factory-made accessories
- 5 Form circular holes over 6mm diameter in trunking body using correctly sized punch sets. Use twist drill for holes up to 6mm maximum diameter
- 6 Use only factory formed openings for accessories
- 7 Line unprotected apertures in trunking with PVC or nylon edging strip
- 8 Fit ends of runs with removable blanking plates
- 9 Ensure connections are not made to covers unless indicated or approval obtained
- 10 Provide fixed section of cover projecting 25mm either side of fabric where trunking passes through wall, floors or ceiling
- 11 Fit cable retaining straps at 500mm intervals except where cover is on top
- 12 Use purpose made brackets to fix to structural steel or suspension rods
- 13 Provide external fixing lugs where specified protection for the installation is IP44 or greater.
- 14 Use bends, tees and angles of similar gauge, type and finish as trunking body and supplied by same manufacturer
- 15 Ensure dividers are electrically continuous with the body of the trunking or provide a connector for a circuit protective conductor
- 16 Ensure gap between dividers and lids maintains segregation of circuits
- 17 Fittings shall be of the same material as the trunking
- 18 Use purpose made jointing pieces fixed with screws into captive nuts. Ensure screws do not protrude through the nuts
- 19 Ensure rigidity of trunking is maintained across joint
- 20 Ensure external dimensions of trunking are maintained and not reduced by more than 4% across joints between trunking lengths and/or fittings
- 21 Use purpose made fittings of the same manufacture where trunking connects to switchgear and distribution boards
- 22 Provide flanges for connection of flush floor trunking to vertical trunking to maintain the cross-sectional area of compartments with 50mm minimum radius
- 23 Maintain electrical continuity at each joint by a copper link, (tinned copper for galvanized trunking), fixed on outside of trunking, secured by screws, nuts and shakeproof washers. Screws must not project through the nut. Make provision for continuity to be achieved without need to remove paint from ferrous metal where trunking has a painted finish
- 24 Do not use self-tapping screws. Use cheese or round head screws except where provision is made for the use of counter-sunk heads
- 25 Screws, nuts and washers material - Use steel zinc coated (coating to BS 4174)
- 26 Provide horizontal trunking with removable cable retainers or bridges to retain cables in situ
- 27 Provide vertical trunking with pin racks to support cables at 3000mm maximum spacing
- 28 Use insulated pins or insulation sleeved pins on pin racks.

Y60.3.8 PVC TRUNKING INSTALLATION (SUSPENDED)

- A Comply with the manufacturer's installation instructions and ensure that only manufacturer's standard fittings are used. Do not install trunking where ambient temperature is below - 5°C or working temperature is above 60°C.
- B Where trunking is to be suspended comply with the following maximum support spacings which give a maximum deflection of 1%.

Suspended PVC trunking support spacing

Trunking size Cross sectional area (mm ²)	Maximum Distance between supports (m)	
	Horizontal	Vertical
Up to 1500	0.5	0.5
Up to 2500	1.25	1.25
Up to 5000	1.5	2.0
Exceeding 5000	1.75	2.0

- C Joints: All lengths of trunking should be connected using an internal or external coupler with 3mm of movement available between consecutive lengths of trunking. Ensure that the external coupler provides a seal and facilitates thermal movement of the trunking due to change in temperature.

Y60.3.9 CABLE BASKET/TRAY INSTALLATION

- A Refer to section Y63 for cable basket installation.

Y60.3.10 PERIMETER/SKIRTING TRUNKING INSTALLATION - STEEL

- A The entire perimeter/skirting trunking system and accessories used shall be supplied and installed strictly according to the recommendations and instructions of the manufacturer.
- B Ensure clearance between trunking body and desk/ floor finish is allowed to fit the cover straps etc
- C Some systems are designed to fit together without the use of screws on the body, lid or component parts, with the exception of the wiring accessory back box.
- D Trunking body**
- 1 Fix the trunking body in accordance with manufacturer's requirements
 - 2 It is recommended to secure at least every metre and near to joints / ends
 - 3 Use washers and dome head screws or plastic caps to avoid damage to cables
 - 4 Do not over tighten
 - 5 Fit trunking body to wall ensuring it is level with preceding length and that joints are closely butted together
 - 6 Once secured, install earthing coupler to trunking joint. Ensure that the coupler is evenly distributed over both parts
 - 7 For best results when cutting, use a fine-tooth circular saw
 - 8 Cut edges must be de-burred to avoid cable damage
 - 9 Where the trunking body is supplied with a protective film to avoid marks and scratches during installation; this can be removed when lids are fitted
- E **Fittings:** Fittings (e.g. bends, tees) are installed in the same manner as the trunking body
- F **Dividers:** The trunking can be divided into two or three compartments. Fit dividers in accordance with the manufacturer's instructions
- G **Back boxes:** Fit the steel back boxes into place and secure in place. 20 mm knockouts are provided on all sides and the base. Once removed, 20 mm grommets should be fitted to protect the cable from the cut edge before feeding cable into box
- H **Lids:** Once the wiring installation is complete, lids are simply clicked into place. Provide earthing cams as required by the manufacturer.

- I **Earthing:** Ensure that the perimeter trunking system is provided with earth continuity when installed. ,

Y60.3.11 PVC PERIMETER/SKIRTING TRUNKING

- A The entire perimeter/skirting trunking system and accessories used shall be supplied and installed strictly according to the recommendations and instructions of the manufacturer.
- B Do not install trunking where ambient temperature is below - 5°C or working temperature is above 60°C.
- C Supports: Ensure clearance between trunking body and desk/ floor finish is allowed to fit the cover straps etc:
- 1 The base should be secured every 500mm by drilling alternating 6mm holes either side of centre as is practical and fasten using No. 8 round head screws with washers
 - 2 Avoid over tightening to permit thermal movement.
- D Joints: All lengths of trunking should be connected using an internal or external coupler with 3mm of movement available between consecutive lengths of trunking. Ensure that the external coupler provides a seal and facilitates thermal movement of the trunking due to change in temperature.
- E 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.
- F Adhesive to be used shall be that recommended by the trunking manufacturer. The trunking shall be butted solidly and cemented (using the manufacturer's approved adhesive) into all fittings.

Y60.3.12 FLUSH LID TRUNKING SYSTEMS INSTALLTION

- A The entire flush floor trunking system and accessories used shall be supplied and installed strictly according to the recommendations and instructions of the manufacturer.
- B Sequence the installations as follows:
- 1 Mark the pathway for trunking and junction boxes
 - 2 Fix risers junction boxes on the trunking and all accessories
 - 3 Adjust boxes to screed depth by adjusting sub-frame height
 - 4 Fix trunking, complete with lids, and all accessories. Use manufacturer's fixing brackets
 - 5 If levelling is required, use levelling kits and do not exceed 1.2 m between levelling brackets
 - 6 Pour concrete screed around the trunking
 - 7 Earth system at least every 10m.
- C Do not cable the installation until the screed is dry and able to be walked on.
- D Cable the installation by removing the covers and fit service outlets where required strictly in accordance with manufacturer's instructions:
- 1 Fit the accessory plates
 - 2 Connect wiring
 - 3 Fit carpet and trims.

Y60.3.13 BURIED SCREED TRUNKING SYSTEMS INSTALLATION

- A The entire buried screed floor trunking system and accessories used shall be supplied and installed strictly according to the recommendations and instructions of the manufacturer. Order floor boxes and junction boxes to suit the lowest anticipated screed depth.
- B Sequence the installations as follows:
- 1 Mark the pathway for trunking, junction boxes and back boxes
 - 2 Fix risers junction boxes and back boxes on the slab
 - 3 Adjust boxes to screed depth by adjusting sub-frame height.
 - 4 Fix trunking, complete with lids, couplers and all accessories. Use manufacturer's fixing brackets
 - 5 Use temporary covers to protect boxes from the ingress of screed

- 6 Pour concrete screed around and over the trunking.
- C Do not cable the installation until the screed is dry and able to be walked on.
- D Cable the installation by removing the temporary box covers and fit service outlets where required strictly in accordance with manufacturer's instructions:
 - 1 Earth the junction boxes
 - 2 Fit the accessory plates
 - 3 Connect wiring and earth the systems
 - 4 Fit carpet and trims.

Y60.3.14 RAISED FLOOR TRUNKING INSTALLATION

- A For locations and density of floor outlet boxes refer to the drawings.
- B Carry out the installation in the following sequence:
 - 1 Remove the raised access floor tiles along the path of the ducting
 - 2 Lay underfloor trunking straight and level
 - 3 Place the junction boxes, risers and flat angles at the required location. Level if required
 - 4 Fix the trunking and all accessories with fixing brackets levelling as necessary
 - 5 Remove all trunking covers to facilitate cabling installation.
 - 6 Cut raised access floor tiles according to backbox size
 - 7 Earth the system (minimum every 10 meters)
 - 8 On trunking, remove knockouts to fit flexible conduit
 - 9 Fix back boxes within the raised floor in accordance with manufacturer's instructions
 - 10 Fix the wiring accessory plates and earth the system
 - 11 Connect wiring
 - 12 Fit carpet and trims.

Y60.3.15 CONDENSATION PREVENTION

- A Install conduit and trunking systems to ensure internal condensation does not affect operation of associated circuits. Provide drainage points in accordance with the requirements of BS7671.
- B Where conduit passes through external wall between two areas of different ambient temperatures or in other locations likely to cause condensation, install a conduit or adaptable box. After wiring fill box with inert, permanently plastic compound with high insulation value.

Y60.3.16 PROTECTION AND REPAIR OF STEEL COMPONENTS

- A Paint joints of conduit and minor damages to finish of conduit and trunking immediately after erection or after damage occurs.
- B Use paint compatible with finish as follows:
 - 1 Galvanized finish, use two coats zinc rich paint
 - 2 Black enamelled finish, use two coats of good quality, air drying, black enamel paint
 - 3 Remove grease, oil, dirt and rust before applying protective paint
 - 4 Notify serious damage and repair or replace as instructed.

Y60.3.17 EQUIPMENT CONNECTIONS

- A Where surface mounted equipment is installed in conjunction with concealed conduit work, terminate concealed conduit at flush mounted conduit or adaptable box. Drill back of equipment, bush for back entry and mount equipment to conceal back box.
- B Connect to fixed equipment via conduit box located adjacent to termination point, using either solid or flexible conduit as indicated for final connection to equipment terminations.

- C Use conduit box as cable change point to facilitate changed wiring locally to adjacent equipment.
- D Connect trunking to equipment by specially fabricated connectors or by couplers and externally screwed brass bushes.

Y60.3.18 WIRING

- A Comply with the requirements of BS7671 and associated Guidance Notes.
- B Segregate circuits as indicated.
- C Ensure draw wires are left within empty conduits for use of specialist installers. Use draw wires comprising nylon tapes with fitted eyelets.
- D For concealed conduit ensure system is installed to enable re-wiring to be carried out from boxes for fittings or accessories only. Draw-in boxes will only be permitted with prior permission in writing.
- E Do not use tallow or any other substances to facilitate drawing-in of cables.

Y60.3.19 INSTALLATION OF CAST-IN OR BURIED CONDUIT

- A Ensure conduit is not concealed until work has been inspected and approved.
- B Obtain permission before horizontally chasing walls.
- C Ensure that conduit and fittings buried in concrete or behind plaster are protected against corrosion or electrolytic action prior to rendering.
- D Ensure conduit concealed in wall chases is covered by plaster and/or rendering to minimum depth of 12mm.
- E Ensure cast-in conduits are firmly secured to reinforcing steelwork and that accessory and/or conduit boxes are secured so they do not move during subsequent building operations.
- F Ensure there is no blockage immediately shuttering is removed.
- G Check there is no mechanical damage to conduit in floor screed prior to screeding. Fix securely before screed is poured. Provide temporary protection to conduits until screeds are laid.
- H Ensure minimum amount of crossovers occur dependent upon screed depth. Do not install draw boxes in floors.
- I Do not install conduits:
 - 1 In screeds in areas indicated
 - 2 Within site blinding
 - 3 In main structural slabs unless prior permission in writing is obtained from CA.

Y60.3.20 CONDUIT BOXES

- A Ensure that, wherever conduit boxes are cast in, the face of the box is flush with the face of the concrete or plaster. Fit circular conduit boxes with extension rings to ensure a flush face with plaster or concrete or where terminal blocks are to be accommodated.
- B Ensure fixing holes are countersunk where material thickness allows or use round head screws to prevent damage to cables and remove burrs before cables are drawn in.
- C Use a minimum of two screw fixing for standard circular conduit boxes and four screws for large conduit boxes and adaptable boxes up to 150mm × 100mm.
- D Use back outlet boxes where surface conduits pass through walls, to outside accessories or lighting points.
- E Secure switch boxes and socket boxes using countersunk steel screws where provision is made for them or if not use round head screws. Use plug inserts and finally grout in position prior to plastering or screeding.

Y60.3.21 BUILDING EXPANSION AND SETTLEMENT

- A Make provision in conduit and trunking at expansion and settlement joints to allow for movement of building structure. Provide circular through or adaptable boxes no more than 300mm either side of expansion or settlement joints for conduit crossing.
- B Join boxes with flexible steel conduit type C or conduits arranged to form a telescopic joint and cover overall with PVC sleeve to provide minimum degree of protection of IP44 or purpose made telescopic joint protected by a PVC sleeve to at least IP44.

Y60.3.22 CONDUIT AND TRUNKING COLOUR CODING

- A In areas of mechanical plant or voids accommodating mechanical services, or where otherwise indicated, identify electrical conduits and ducts in accordance with BS 1710. Apply colour orange to BS 4800 by painting on service as a band over 150mm or applying an adhesive tape type wrap around services over a length of 150mm.
- B Place identification colours at bulkheads, wall penetrations and any other place where identification is necessary.

Y60.3.23 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- B Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- C Rectangular Sleeve Minimum Metal Thickness:
 - 1 For sleeve cross-section rectangle perimeter less than 1270 mm and no side greater than 400 mm, thickness shall be 1.3 mm
 - 2 For sleeve cross-section rectangle perimeter equal to, or greater than, 1270 mm and 1 or more sides equal to, or greater than, 400 mm, thickness shall be 3.5 mm.
- D Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with fire-stop system used are fabricated during construction of floor or wall. Refer to section Y90.
- E Cut sleeves to length for mounting flush with both surfaces of walls as indicated on the standard details.
- F Extend sleeves installed in floors 50 mm above finished floor level.
- G Size pipe sleeves to provide 5mm annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- H Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- I Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint.
- J Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with fire-stop materials.
- K Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- L Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 25-mm annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 25-mm annular clear space between raceway and sleeve for installing mechanical sleeve seals.

Y60.3.24 SLEEVE-SEAL INSTALLATION

- A Install to seal underground, exterior wall penetrations.
- B Use type and number of sealing elements recommended by manufacturer for conduit material and size. Position conduit in centre of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Y60.3.25 FIRE-STOPPING

- A Apply fire-stopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Fire-stopping materials and installation requirements shall be appropriate for this purpose. Refer to section Y90.

Y60.3.26 PROTECTION

- A Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion:
 - 1 Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer
 - 2 Repair damage to PVC or paint finishes with matching touch-up coating recommended by manufacturer.

Y60.3.27 FIELD QUALITY CONTROL

- A After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:
 - 1 Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage
 - 2 Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by BS7671. Verify that communication or data-processing circuits are separated from power circuits by barriers
 - 3 Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables
 - 4 Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation
 - 5 Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas
 - 6 Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 - 7 Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all take-off raceways are bonded to cable tray.
- B Report results in writing.

Y61 LV AND ELV CABLES

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Y61.1 PART 1- GENERAL

Y61.1.1 RELATED DOCUMENTS

- A For drawings and general provisions of the Contract refer to the main contract preliminaries and section A of this specification.
- B For performance details and physical sizes of cables and equipment refer to section D "Schedules of Equipment"
- C For system descriptions, operating parameters and ambient temperatures refer to section B of this specification and the Schedules of Equipment.
- D Refer also to the following sections:
- 1 V80: Electrical Identification
 - 2 V81: Earthing and Bonding
 - 3 Y50: Testing and Commissioning of Mechanical and Electrical Services
 - 4 Y60: Conduit and Trunking
 - 5 Y63: Cable Supports
 - 6 Y90: Fixing to Building Fabric
- E For specialist cabling requirements refer to the following sections:
- 1 W60: Lightning Protection

Y61.1.2 SUMMARY

- A This Section includes the following:
- 1 LV cabling
 - 2 Fire and Life safety cabling
 - 3 Support systems
 - 4 Sleeves and sleeve seals for cables
 - 5 Cable installation
 - 6 Underground cabling

Y61.1.3 DEFINITIONS

- A The following acronyms are used in this specification
- 1 A.C.: Alternating Current
 - 2 BASEC: British Approvals Service for Cables
 - 3 BMS: Building Management System
 - 4 BSRIA: Building Services Research and Information Association
 - 5 CENELEC: European Committee for Electrotechnical Standardisation
 - 6 COP: Code of Practice
 - 7 CWZ: This refers to BS 6387. Cables comply with the following tests:
 - C – Resistance to fire at 950°C for 3 hours
 - W – Resistance to fire and water at 650°C for 30 minutes
 - Z – Resistance to fire and mechanical shock at 915°C for 15 mins
 - 8 D.C: Direct Current
 - 9 ECA: Electrical Contractors Association
 - 10 ELV: Extra Low Voltage:
 - a A.C. <50V
 - b D.C. <120V ripple-free
 - 11 HV: High Voltage: Voltage $\geq$ 35kV but for this document also includes MV
 - 12 IET: Institution of Engineering and Technology

- 13 LPCB: Loss Prevention Certification Board
- 14 LSZH/LSOH: Low Smoke Zero Halogen
- 15 LUL: London Underground Ltd
- 16 LV: Low Voltage: Voltage
 - a A.C: $\geq 50V$ and $\leq 1000V$ or $600V$ between conductors and earth
 - b D.C: $\leq 1500V$ between conductors or $900V$ between conductors and Earth
- 17 MCC: Motor Control Centre
- 18 MICC: Mineral Insulated Copper Conductor
- 19 MV: Medium Voltage: Voltage $\geq 1.0kV$ and $\leq 35kV$ referred to as HV in this document
- 20 PA: Public Address System
- 21 PAVA: Public Address and Voice Alarm system
- 22 PH15,30,60,90,120: The ability of electrical cables or optical cables to maintain a reliable form of power supply or signal from the source to the safety installation(s) when exposed to fire. The performance criterion is continuity of power supply or signal. The PH classification refers to a constant temperature attack of a notional $842^{\circ}C$. Classification. PH 15, 30, 60, 90, 120 in which the measured duration in minutes of survival equals or exceeds the stated classification.
- 23 rh: relative humidity
- 24 SCADA: Supervisory Control and Data Acquisition.
- 25 SWA: Steel Wire Armoured
- 26 XLPE: Crosslinked Polyethylene

B Cable core colour codes:

- 1 Bn: Brown
- 2 Be: Blue
- 3 Bk: Black
- 4 Gy: Grey
- 5 Gn/Yw: Green/Yellow
- 6 Rd: Red
- 7 We: White

Y61.1.4 PERFORMANCE REQUIREMENTS

- A** Provide a system for the distribution of HV, LV, fire alarm, PAVA, emergency lighting, security, data and other wiring systems indicated in the drawings, other parts of specification section C and also as identified in section B of this specification. Ensure that the installing company is a member of the ECA.
- B** **Power wiring:** Size all current-carrying conductors (cables, busbars etc) to carry their design load after the application of any de-rating factors generated by their installation environment and in accordance with manufacturers' data. All cables should be of an approved type tested by an external body such as:
 - 1 Electrical Cables (BASEC)
 - 2 CENELEC.
 - 3 The conductor size should limit the volt drop between the network origin and point of use to the values given in BS 7671 IET Wiring Regulations.
 - 4 Optimise the conductor power dissipation (I^2R losses) by designing the final circuits to carry the majority of the permissible volt drop.
- C** **Life Safety and Firefighting Power supplies:** Comply with the requirements and recommendations of:
 - 1 BSRIA BG 70/2017: Life Safety and Firefighting power supplies
 - 2 BS EN 1366 Series of standards: Fire resistance tests for service installations
 - 3 BS 8519: Selection and installation of fire-resistant power and control cable systems for life safety and fire-fighting applications. Code of practice. Note the following:
 - a Primary and secondary sources of supply should be diversely routed and adequately separated to ensure that a failure of either cable/containment system does not affect the alternative supply

- b Protect against fire and water damage for the minimum period of the specified fire survival time for the applications of table 1 BS 8519
- c Life safety and firefighting cabling should be segregated from non-life safety cables. Provide dedicated Life Safety and firefighting cable containment designed to maintain its integrity under fire conditions for the specified fire survival time.

D **Control communication and non-fire-alarm cables:** Liaise with system suppliers before selecting the type of cabling used for general communication and alarm systems. The distribution and installation of alarm and communication systems should follow (as far as practical) the general route of containment used for power systems, provided a suitable segregation distance (100 mm to 300 mm depending on voltage screening bands) is maintained.

E **Information technology cables:** Liaise with the IT provider and coordinate the containment routing for such systems. IT containments should be in separate vertical risers to any other building services containment route.

- 1 Horizontal containment used for IT should be at least 300 mm to 600 mm from other building services containment, subject to the voltage band of any distributed power cabling system.
- 2 The IT distribution strategy and separation distance are exclusive of any maintenance access requirements that should also be considered.

F **Containment and support systems:** Provide a system for the support of a combination of cables, electrical equipment and/or communication system installations as indicated on the drawings. Where necessary cable tray systems may be used for the segregation of cables. Use as indicated on the drawings, as indicated in section B of this specification or where not shown comply with the following general applications:

- 1 **Perforated Cable tray:** Use for applications where some physical strength is required typically where system is exposed to view including Data, LV sub mains cabling, fire alarm, shorter spans and medium loads and medium heat producing cables
- 2 **Cable Ladder rack:** Use for Main LV & HV cabling and sub mains distribution, greatest heat generating cables and for longer spans and heaviest loads
- 3 **Cable basket:** Use for Fire Alarm, PAVA, BMS, Data, Voice, Lighting control and Comms installations in false ceilings and raised floor where greater ventilation is required. Spans are shorter and lighter loading. Physical protection is limited
- 4 **Cable trunking:** Use for final LV circuits, single cables, Data, Comms, security, fire alarm and BMS cables. Spans short and lighter loading.
- 5 **Conduits:** Use when services are surface mounted or embedded in walls or floor screeds
- 6 **Flexible Conduit:** Use for final connections to motors, other equipment subject to vibration or adjustment and to thermostats, motorised valves and similar items mounted in pipelines or ducts
- 7 **Perimeter trunking:** use to provide power and communication services above desk top level or at skirting level for office/workshop type areas without floor distribution systems. Installations should ensure compliance with the Disability Discrimination Act 2005 and the Building Regulations
- 8 **Underfloor trunking:** use to provide power and communication systems to office type areas where a flexible/adaptable layout is required.
- 9 **Refer to section Y60 and Y63 for detailed containment and supporting requirements.**

Y61.1.5 SUBMITTALS

A Provide the requirements as indicated in section A and section B of this specification. This will include:

- 1 Installation, builderswork and record drawings.
- 2 Verification of cable sizes based on the co-ordinated working drawings, selected equipment and cable lengths including those for specialist systems such as fire alarm, data, comms, CCTV, and access control.
- 3 Calculations for all cable support systems
- 4 Information for incorporation into the Operation and Maintenance Manuals

B Product Data: For each type of cabling product provide the following:

- 1 Samples: 400-mm lengths
 - 2 Product data sheets
 - 3 Approval certification
 - 4 Termination methods
 - 5 Cable accessories and support details
- C Final Cable sizing schedules
- D Site testing reports. (refer to Y50)
- E Site Integrated commissioning (refer to Y50)

Y61.1.6 QUALITY ASSURANCE

- A Ensure that the design, construction, materials and finishes of all equipment are suitable for the location, climatic and operating conditions to which the installation shall be exposed.
- B Ensure that the whole installation complies with the relevant standards, including the following:
- 1 BS 6387: Specification for performance requirements for cables required to maintain circuit integrity under fire conditions
 - 2 BS 6724: Electric cables. Thermosetting insulated, armoured cables for voltages of 600/1000 V and 1900/3300 V, having low emission of smoke and corrosive gases when affected by fire
 - 3 BS 7211 - Electric cables. Thermosetting insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring, and having low emission of smoke and corrosive gases when affected by fire
 - 4 BS 7629-1 Electric cables. Specification for 300/500 V fire resistant screened cables having low emission of smoke and corrosive gases when affected by fire. Multicore cables
 - 5 BS 7655: All parts Specification for insulating and sheathing materials for cables
 - 6 BS 7671+A3 - Requirements for electrical installations. IET Wiring Regulations. Seventeenth edition
 - 7 BS 7846: Electric cables. Thermosetting insulated, armoured, fire-resistant cables of rated voltage 600/1000 V for fixed installations, having low emission of smoke and corrosive gases when affected by fire. Specification
 - 8 BS 8434-2+A2 - Methods of test for assessment of the fire integrity of electric cables. Test for unprotected small cables for use in emergency circuits. BS EN 50200 with a 930° flame and with water spray
 - 9 BS 8491 - Method for assessment of fire integrity of large diameter power cables for use as components for smoke and heat control systems and certain other active fire safety systems.
 - 10 BS 8519 - Selection and installation for fire resistant power and control cable systems for life safety and firefighting cables. Code of practice.
 - 11 BS EN 10143 - Continuously hot-dip metal coated steel sheet and strip. Tolerances on dimensions and shape
 - 12 BS EN 10217-7 - Welded steel tubes for pressure purposes. Technical delivery conditions. Stainless steel tubes
 - 13 BS EN 10346 - Continuously hot-dip coated steel flat products. Technical delivery conditions
 - 14 BSEN 1401-1 - Plastic piping systems for non-pressure underground drainage and sewerage. Unplasticized poly (vinyl chloride) (PVC-U). Specifications for pipes, fittings and the system
 - 15 BS EN 50200 - Method of test for resistance to fire of unprotected small cables for use in emergency circuits.
 - 16 BS EN 50525-1: Electric cables. Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U). General requirements
 - 17 BS EN 50525-2-11: Electric cables. Low voltage energy cables of rated voltages up to and including 450/750V (U0/U). Cables for general applications. Flexible cables with thermoplastic PVC insulation
 - 18 BS EN 50525-2-12: Electric cables. Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U). Cables for general applications. Cables with thermoplastic PVC insulation for extensible leads

- 19 BS EN 50525-2-21: Electric cables. Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U). Cables for general applications. Flexible cables with crosslinked elastomeric insulation
- 20 BS EN 50525-2-41: Electric cables. Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U). Cables for general applications. Single core cables with crosslinked silicone rubber insulation
- 21 BS EN 50525-2-42: Electric cables. Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U). Cables for general applications. Single core non-sheathed cables with crosslinked EVA insulation
- 22 BS EN 50525-2-71: Electric cables. Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U). Cables for general applications. Flat tinsel cables (cords) with thermoplastic PVC insulation
- 23 BS EN 60702-1 - Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V. Cables
- 24 BS EN 60702-2 - Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V. Terminations
- 25 BS EN 61034-1 - Measurement of smoke density of cables burning under defined conditions. Test apparatus
- 26 BS EN 681 all parts: Elastomeric seals. Material requirements for pipe joint seals used in water and drainage applications

Y61.1.7 CO-ORDINATION

- A Co-ordinate layout and installation of electrical with other services, HVAC equipment, and architectural elements and partition assemblies.
- B Comply with separation distances between different services above and below ground. Refer also to electrical standard details.
- C Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed. Provide fire rated conduits and proprietary fire rated cable transits where required.

Y61.2 PART 2 – PRODUCTS

Y61.2.1 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A All cables to be of BASEC manufacture and of the low smoke, zero halogen type for indoor and outdoor installation except where indicated otherwise.
- B Cabling to be as indicated in section B, the cable schedules section D of this specification and as indicated on the drawings. Where not indicated comply with the following cable types.
- | | | | |
|----|--|--|------------|
| 1 | Sub-main LV distribution: | | |
| a | Multi Core Armoured cable: | BS 6724: LSZH Armoured Cable | (Y61.2.8) |
| 2 | Final LV circuits: | | |
| a | Single core cabling: | BS 7211 LSZH LV 6491B (HO7Z-R) | (Y61.2.5) |
| b | Twin & Earth cable: | BS 7211 Twin & Earth LSZH | (Y61.2.4) |
| 3 | Earth cabling: Single core: | BS 7211 LSZH LV 6491B (HO7Z-R) | (Y61.2.5) |
| 4 | Lighting & Power final connections | BSEN 50525-3-11 H0Z1Z1-F | (Y61.2.16) |
| | Emergency Lighting: | Refer to Table 1 | |
| 5 | External landscape lighting: | BS 6724: LSZH Armoured Cable | (Y61.2.8) |
| 6 | Aircraft/Marine Navigation Lighting: | BS EN 60702-1 MICC Heavy Duty White | (Y61.2.9) |
| 7 | Fire alarm/ Lift/MCC interface: | BS 7846 Fire resistant armoured | (Y61.2.14) |
| 8 | Fire alarm/Lift/MCC (extra robust): | BS 7846 Fire resistant impact armoured | (Y61.2.15) |
| 9 | Mechanical services supplies from MCCs: | BS 6724: LSZH Armoured Cable | (Y61.2.8) |
| 10 | Final Connections to luminaires from rose: | BSEN 50525-3-11 H0Z1Z1-F | (Y61.2.16) |
| 11 | Final Flexible conn to mechanical equipment: | BSEN 50525-3-11 H0Z1Z1-F | (Y61.2.16) |
| 12 | Final connections to mechanical plant | | |
| a | Where run in conduits: | BS 7211 LSZH LV 6491B (HO7Z-R) | (Y61.2.5) |
| b | Where run on cable tray | BS 6724: LSZH Armoured Cable | (Y61.2.8) |
| 13 | Data/IT/Comms/Special systems cabling: | Refer to the following specification sections: | |
| a | Y41: Building Management Systems | | |
| b | W11: Public Address Systems | | |
| c | W16: Induction Loop systems | | |
| d | W20: Television Distribution | | |
| e | W31: Data Distribution | | |
| f | W40: Access Control Systems | | |
| g | W41: Intruder Detection Systems | | |
| h | W44: Closed Circuit Television Systems | | |
| i | W52: Assistance Call Systems | | |
| j | W54: Nurse Call Systems | | |
| k | W60: Lightning Protection Systems | | |
- C For London Underground installations use only LUL approved cabling.
- D For healthcare installations comply with the requirements of HTM06.

Y61.2.2 FIRE ALARM AND LIFE SAFETY CABLING

- A Cables serving fire alarms, firefighting equipment and life safety equipment: Cables to comply with the following categories as defined in BS 8519 and set out in the table below:
- Category 1:** Means of escape 30mins
 - Power cables > 20mm diameter:
 - Tested: BS 8491 with 30 mins fire survival time
 - Control cables <20mm diameter
 - Tested to BS EN 50200, PH 30 + Annex E 30 mins
 - Category 2:** Means of escape 60 mins

- a Power cables (>20 mm diameter)
 - Tested in accordance with BS 8491 with 60-minute fire survival time
 - b Control cables (<20 mm diameter)
 - Tested in accordance with BS EN 50200 with 60-minute fire survival time (PH60), with the additional requirements of BS 8434-2, 120 mins
 - c Three-phase power circuits are excluded.
- 3 **Category 3:** Firefighting (120-minute fire survival time)
- a Power cables (>20 mm diameter)
 - Tested in accordance with BS 8491 with 120-minute fire survival time
 - b Control cables (<20 mm diameter)
 - Tested in accordance with BS EN 50200 with 120-minute fire survival time (PH120), when tested in accordance with BS 8519 Annex B 120 mins
 - c Three-phase circuits are excluded.

B Applications: The following schedule indicates the suitability of various cable types for different applications and the minimum fire survival time categories (Table 1 adapted from BS 8519).

Table 1: Fire Fighting and Life Safety Cable Types and Survival Time Categories

SYSTEMS	Application	Related Standards	Minimum category	BH Cable type Required Clause Reference	Duration (mins) based on BH cable type
POWER CABLES					
Sub Mains Power	Fire Fighting	BS 8519	2	Y61.2.14/Y61.2.15	120
	Means of Escape	BS 8519	1	Y61.2.14/Y61.2.15	120
SYSTEM CABLES					
Fire Alarms	Standard	BS 5839-1	1	Y61.2.11	30
	Enhanced	BS 5839-1	3	Y61.2.12	120
Voice Alarm	Standard	BS 5839-8	1	Y61.2.13	30
	Enhanced	BS 5839-8	3	Y61.2.13	120
Emergency Voice	Fire/emergency telephone	BS 5839-9	3	Y61.2.13	120
Disabled evacuation refuges	Refuges	BS 5839-9	3	Y61.2.13	120
CCTV			2	Y61.2.15	
Emergency Lighting Standard	Emergency Escape	BS 5266-1	2	Y61.2.11	60
	Escape Route	BS 5266-1	2	Y61.2.11	60
	Central Battery	BS 5266-1	2	Y61.2.11	60
Emergency Lighting Enhanced	Emergency Escape	BS 5266-1	3	Y61.2.12	120
	Escape Route	BS 5266-1	3	Y61.2.12	120
	Central Battery	BS 5266-1	3	Y61.2.12	120
Fire Fighting	Car Park Smoke fans	BS 7346-7	3	Y61.2.14	120
	Areas of specials fire risk		3	Y61.2.15	120
	Motorised Fire and smoke	BS EN	3	Y61.2.14	120

SYSTEMS	Application	Related Standards	Minimum category	BH Cable type Required Clause Reference	Duration (mins) based on BH cable type
	dampers FSDs	12101-8			
	Smoke barriers/curtains	BS EN 12101	3	Y61.2.14	120
	Fire Barrier	BS 8524	3	Y61.2.14	120
	Fire Natural smoke & heat exhaust vent (SHEVS)	BS EN 12101-2	2	Y61.2.14	120
	Powered SHEVS	BS EN 12101-3	3	Y61.2.14	120
	Smoke Fans	BS EN 12101-3	3	Y61.2.14	120
	Pressurisation fans	BS EN 12101-6	3	Y61.2.14	120
	Firefighting activation/monitoring		3	Y61.2.12	120
Means of Escape	Car park Smoke Control	BS 7346-7	2	Y61.2.14	120
	Areas of specials fire risk		3	Y61.2.15	120
	Motorised Fire and smoke dampers FSDs	BS EN 12101-8	2	Y61.2.14	120
	Smoke barriers/curtains	BS EN 12101	2	Y61.2.14	120
	Fire Barrier	BS 8524	2	Y61.2.14	120
	Fire Natural smoke & heat exhaust vent (SHEVS)	BS EN 12101-2	2	Y61.2.14	120
	Powered SHEVS	BS EN 12101-3	2	Y61.2.14	120
	Smoke Fans	BS EN 12101-3	3	Y61.2.14	120
	Pressurisation fans	BS EN 12101-6	2	Y61.2.14	120
	Means of Escape activation/monitoring		2	Y61.2.11	60
	Powered Sliding doors	BS 7273-4	2	Y61.2.14	120
Fire Fighting Shafts	Pressurisation	BS EN 12101-6	3	Y61.2.14	120
	Controlled MFSD	BS 9999	3	Y61.2.14	120
	Emergency Lighting	BS 9999	3	Y61.2.12	120
	System monitoring	BS 9999	3	Y61.2.12	120
	Fire-fighting Lifts	BS 9999	3	Y61.2.15	120
	Communications	BS EN 81-72	3	Y61.2.13	120

SYSTEMS	Application	Related Standards	Minimum category	BH Cable type Required Clause Reference	Duration (mins) based on BH cable type
Lifts	Evacuation Lifts	BS 9999	2	Y61.2.15	120
	Evacuation communications		2	Y61.2.13	120
Fire Suppression	Gaseous extinguishing	BS EN 12094	2	Y61.2.14	120
	Water mist	BS 8489	3	Y61.2.15	120
	Sprinkler pumps	BS EN 12845	3	Y61.2.15	120
	Foam	BS EN 13565	3	Y61.2.15	120
	Hose reel systems	BS 5306-1	3	Y61.2.14	120
	Water Spray	DD CEN/TS 14816	3	Y61.2.15	120
	Suppression system monitoring		2	Y61.2.12	60
Fire Mains	Wet riser pumps	BS 9990	3	Y61.2.15	120
	Valve and equipment monitoring		3	Y61.2.12	60

Y61.2.3 FIRE AND LIFE SAFETY CABLE PROPERTIES

- A Depending upon the application select power and control cables to suit the particular properties required and for compliance with the relevant standards.
- B Select cables from one of the following manufacturers: All cables to be sourced from a single manufacturer where possible.
- 1 Prysmian
 - 2 Draka
 - 3 AEI
- C Note that methods of cable support are an integral part of the compliance with the particular standards and the manufacturer's support details and fixing methods should be strictly observed.
- D Table 2 illustrates fire and life safety properties for various types of cables supplied/manufactured by various manufacturers. Equivalent cable types may be sourced from alternative manufacturers subject to approval by the CA and submission of suitable product details, certification and technical compliance with standard

Y61-1 Fire and Life Safety Cable Properties																																		
Spec Clause Ref	Manufacturer's ref	Manufacturer	Protection	Cable Sizes	Manufacturing Standards			Application Standards							Resistance to Fire standards							LSOH Cable Reaction to Fire				Certification								
					BS 7629-1	BS 7846	Insulation	BS 5839-1 (Fire Detection and Alarm)	BS 5266-1 (Emergency Lighting)	BS 5839-8 (PAVA)	BS 5839-9 (Fire and Emergency Telephone)	BS 8519 (Life Safety & Fire Fighting)	HTM 05-03 Part B (Fire Detection and Alarm systems)	HTM 05-03 Part E (Escape Lifts in Health care premises)	BS6387 CAT CWZ (3 sep samples)	All tests conducted on same sample						BS EN 60331-21 (flame retardant)	BS EN 60332-3(series) (reduced flame propagation)	BS EN 60754-1 (acidic gas emission)	BS EN 61034-2 (Low smoke emission)	BASEC	LPCB	London Underground (S1085) (see note 2)						
																BS EN 50200: Annex E (flame, shock & water spray)	BS EN 50200 (flame & shock only)	BS 8434-2 (flame, shock & water spray)	BS 8491 (flame, direct impact & water jet)	BS 8519: Annex B (115mins flame, shock then 5 mins water spray)	IEC 60331-21 (750°C flame for 90 mins)													
Y61.2.6	FP100	Prysmian		single core 1.5-630mm²			Mica/Glass/XLPE									when tested in steel conduit					when tested in steel conduit	✓		✓	✓		✓							
Y61.2.11	FP200 Gold	Prysmian		2,3,4 core 1.5-4mm²	✓		BS EN 50363-5 - E15	Standard	Standard		Standard		Cat 1 (Control)			✓	30 min	PH30 & PH60				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Y61.2.12	FP Plus	Prysmian		2,3,4 core 1.5-4mm²	✓		BS EN 50363-5 - E15	Enhanced	Enhanced	Enhanced	Enhanced		Cat 2 (Control)			✓		PH120	120 min			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Y61.2.13	FP 400	Prysmian		2,3,4 core 1.5-400 mm²		F2	MGT/XLPE/LSZH						Cat 1 power			✓	30 min	PH120				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Y61.2.14&15	FP 600S	Prysmian		2,3,4, core 4-400 mm²		F120	BS7665 - GP8 Grade						Cat 1,2,3 power			✓	✓			120 min		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Y61.2.14&15	FP 600S	Prysmian		5 core 4 - 35 mm²		F120	BS7665 - GP8 Grade						Cat 1,2,3 power			✓	✓			120 min		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Y61.2.14	FTP120 Enhanced BS7846	Draka	Armoured	2,3,4 core 4-400mm² BS EN 60228 class 2		F120	MGT/XLPE/LSZH						Cat 1,2,3 (Power)						120mins							✓	✓							
Y61.2.8	FireTuf FTP	Draka	Armoured	2,3,4 core 1.5-400mm² BSEN60228 Class 1		F2	XLPE/SWA/LSZH									✓							✓	✓	✓									
Y61.2.11	FireTuf FT30 Saffire	Draka	Unarmoured CWZ	2,3,4 core 1.5-2.5 mm²	✓		MGT/SIF/CAM/LSZH	standard	standard							✓		PH30, PH60, PH120	120 mins			✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		
Y61.2.12	FireTuf FT120 Enhanced	Draka	Unarmoured CWZ	2,3,4 core 1.5-4.0 mm²	✓		MGT/SIF/CAM/LSZH	enhanced	enhanced							✓		PH30, PH60, PH120				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Y61.2.11&13	Firetec Standard	AEI	unarmoured	2,3,4 core 1.5-4.0 mm²	✓		AI/LSZH	Standard	standard	standard			Cat 1 (control)			✓		PH30, PH60, PH120					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Y61.2.12&13	Firetec Enhanced	AEI	unarmoured	2,3,4 core 1.5-4.0 mm²	✓		MGT/AI/LSZH	enhanced	standard	standard			Cat 1 &2 (control)			✓		PH30, PH60, PH120					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Y61.2.15	Firetec Impact Power	AEI	armoured	2,3,4 core 4-400mm²		F2 F120	MGT/XLPE/SWA/LS																											

Y61.2.4 BS 7211 TWIN AND EARTH CABLE 6242B

- A Application: BS 7211 Flat LSZH sheathed low voltage wiring cable typically used for small power and lighting applications. Individual cores are XLPE insulated with two and three core options available, both include an additional un-insulated circuit protective conductor. Cables are thermosetting insulated, unarmoured cables for voltages up to and including 450/750V, for electric power, lighting & internal wiring, and having low emission of smoke and corrosive gases when affected by fire.
- 1 Voltage: 450/750 V
 - 2 Manufacturer/Supplier:
 - a Cleveland Cable Company
 - b Eland Cables
 - c Batt
 - 3 Construction:
 - a Solid or stranded plain annealed copper wire (Class 1 or Class 2) to BS EN 60228.
 - b CPC: Un-insulated copper circuit protective conductor (CPC)
 - c Insulation: XLPE
 - d Sheath: LSZH
 - 4 Minimum Bending Radius
 - a Up to 10mm: 3 x: overall diameter (major axis)
 - b 10mm to 25mm: 4 x overall diameter (major axis)
 - 5 Core Identification:
 - a 2 core Bn, Be
 - b 3 core Bn, Bk, Gy
 - 6 Sheath Colour: White
 - 7 Manufacturing and Test Standard:
 - a BS 7211
 - b BS EN 60754-1 & 2
 - c BS EN 50267-2-1
 - 8 Minimum temperature for installation purposes is 0°C

Y61.2.5 BS 7211 SINGLE CORE LSZH LV CABLES 6491B (HO7Z-R)

- A Application: Low Smoke Zero Halogen (LSZH) for Conduit Wiring. Use in situations where smoke and acid gas emission from fire affected cables would be hazardous to people and equipment. Primarily for use within conduit or trunking but may also be used where suitable protection against mechanical damage exists eg within light fittings, switchgear and control gear.
- 1 Voltage Rating: 450/750kV
 - 2 Manufacturer/Supplier:
 - a Eland Cables
 - b Cleveland Cable Company
 - c Batt Cables
 - d AEI:
 - 3 Approvals:
 - a BASEC
 - b LPCB
 - 4 Construction:
 - a Stranded plain copper conductors
 - sizes 1.5mm² to 630mm²
 - b LSZH/LSOH insulation
 - 5 Operating Temperature: -15°C to +90°C
 - 6 Minimum Bending Radius
 - a 3 x: 1.5mm² to 25mm²

- b 4 x:35mm² to 185mm²
 - c 6 x: 240mm² to 630mm²
- 7 Core Identification: Bn, Be, Bk, Gy, Gn/Yw, Rd, We
- 8 Sheath Colour: N/A
- 9 Manufacturing Standard:
 - a BS EN 50525-3-41: Table B1
 - b BS 7211: Table 3a
- 10 COP/Guide to Use BS 7540
- 11 Fire Tests N/A
 - Emissions and Flame Propagation
 - a BS EN 50267 (IEC 60754) Acid Gas Emission
 - b BS EN 50268 (IEC 61034) Smoke Emission
 - c BS EN 50265 (IEC 60332) Flame Propagation
- 12 Special Notes:
 - a Where a conductor operates at a temperature exceeding 70°C ascertain that the equipment connected to the conductor is suitable for the conductor operating temperature.
 - b Min temperature for installation: +5°C

Y61.2.6 BS 6837 FIRE RESISTANT SINGLE CORE CABLES FOR CONDUIT WIRING

- A Application: Fire resistant essential safety circuits where the cable is protected by metal conduit. Use in situations where smoke and acid gas emission from fire affected cables would be hazardous to people and equipment. May be used for emergency lighting, fire alarm systems that do not require a twisted pair or a built in metallic screen.

- 1 Voltage Rating: 450/750kV and 600/1000V
- 2 Manufacturer:
 - a Prysmian: FP100
- 3 Approvals:
 - a LPCB
- 4 Construction:
 - a Stranded plain annealed copper conductors
 - sizes 1.5mm² to 630mm²
 - b XLPE filled insulation
- 5 Operating Temperature: -25°C to +90°C
- 6 Minimum Bending Radius
 - a ≤8mm diameter: 4 X D mm
 - b >8mm diameter: 6 X D mm
- 7 Core Identification: Bn, Be, Bk, Gy, Gn/Yw, Rd, We
- 8 Sheath Colour: Red
- 9 Manufacturing Standard:
 - a BS 6837: cat C, W, Z
- 10 Fire performance: BS EN 60332-1-2: Fire Resistant
- 11 Emissions and Flame Propagation
 - a BS EN 50267 (IEC 60754) Acid Gas Emission
 - b BS EN 50268 (IEC 61034) Smoke Emission
 - c BS EN 50265 (IEC 60332) Flame Propagation

Y61.2.7 BS 7846 CWZ FIRE RESISTANT UNARMoured MULTICORE CABLE STANDARD

- A Application: Fire resistant unarmoured cable to BS 6387 no longer required in UK emergency services but meets the requirements of the construction standard BS7846 with classification F2. Suitable for use where the risk of mechanical damage is low. Third party certification by BASEC and LPCB.

- 1 Voltage rating: 300/500V

- 2 Manufacturers:
 - a AEI: Firetec Unarmoured
 - b Draka:
 - c FP 400.
- 3 Approvals:
 - a BASEC
 - b LPCB
- 4 Construction: Plain annealed copper conductors or stranded copper. BS EN 60228 Class 1& 2
 - a Fire screen: Mica-glass tapes
 - b Insulation: XLPE
 - a LSZH/LS0H insulation and outer sheath.
- 5 Sizes:
 - a 2 core: 1.5mm² to 16.0 mm²
 - b 3 core: 1.5mm² to 16.0 mm²
 - c 4 core: 1.5mm² to 16.0 mm²
- 6 Minimum Bending Radius 6 x overall diameter
- 7 Core Identification:
 - a 2 core Bn, Be
 - b 3 core Bn, Bk, Gy
 - c 4 core Bn, Bk, Gy, Be
- 8 Sheath Colour: Black.
- 9 Manufacturing Standard: BS 7846 (generally to)
- 10 Fire Tests
 - a BS 6387: C W & Z
 - b BS 7846: F1&F2
- 11 Emissions and Flame Propagation
 - a BS EN 60754 (BS EN 50267) Acid Gas Emission
 - b BS EN 61034-2 (BS EN 50268) Smoke Emission
 - c BS EN 60332-1-2 (BS EN 50265,50266) Flame Propagation

Y61.2.8 BS 6387 LSZH ARMoured CABLE

A Application: LSZH Armoured cables for use in fixed installations in industrial areas, buildings and similar applications. For use in situations where smoke and acid gas emission from fire affected cables would be hazardous to people and equipment. They may be installed in air, on trays, clipped direct or be buried in the ground.

- 1 Voltage Rating: 600/1000V
- 2 Manufacturer:
 - a Draka: FireTuf FTP
- 3 Approvals:
 - a LUL 1-85 (If required)
 - b BASEC
 - c LPCB
- 4 Construction:
 - a Stranded plain copper conductors' sizes
 - 1 core: 50mm² to 1000mm²
 - 2 core: 1.5mm² to 400mm²
 - 3 core: 1.5mm² to 400mm²
 - 4 core: 1.5mm² to 400mm²
 - b XLPE insulation,
 - c cores laid up,
 - d LSZH bedding,
 - e single core AWA 2 or more cores SWA,

- f LSZH sheath.
- 5 Operating Temperature: -15°C to +90°C
- 6 Minimum Bending Radius
 - a 8 x: circular conductors
- 7 Core Identification:
 - a 1 core Bn or Be
 - b 2 core Bn, Be
 - c 3 core Bn, Bk, Gy
 - d 4 core Bn, Bk, Gy, Be
 - e 5 core Gn/Yw, Be, Bn, Bk, Gy
 - f Multicore: white cores with black printed numbers
- 8 Sheath Colour: Black
- 9 Manufacturing Standard:
 - a BS 6387
 - b BS7846
- 10 Fire Tests:
 - a BS 6387, cat C, W, Z
 - b BS 7846 F2
- 11 Emissions and Flame Propagation
 - a BS EN 50267 (IEC 60754) Acid Gas Emission
 - b BS EN 50268 (IEC 61034) Smoke Emission
 - c BS EN 50265,50266 (IEC 60332) Flame Propagation

Y61.2.9 BS EN 60702-1 MINERAL INSULATED CABLE HEAVY DUTY

A Application: Mineral insulated cable delivers ultimate fire performance. Use for data transmission, and security of power and control circuits. It exceeds the requirements of BS8519-1 providing circuit integrity to 950°C. It exceeds enhanced grade requirements defined by BS 5839-1 26.2e and satisfies all Cat 1, 2 & 3 Power, and all Cat 1, 2 & 3 Control requirements defined by BS8519.

- 1 Voltage Rating: 750V
- 2 Manufacturer:
 - a AEI
 - b Mineral Insulated Cable Company
- 3 Construction:
 - a Solid copper conductor sizes:
 - 1 core: 6mm² to 240mm²
 - 2 core: 1.5mm² to 25 mm²
 - 3 core: 1.5mm² to 25mm²
 - 4 core: 1.5mm² to 25mm²
 - b Compressed magnesium oxide powder insulation.
 - c Cores laid up
 - d Solid copper sheath
 - e Thermoplastic LSZH sheath.
- 4 Operating Temperature: -10°C to +250°C
- 5 Minimum Bending Radius: 6 x overall diameter
- 6 Sheath Colour:
 - a Red,
 - b White
 - c Orange.
- 7 Manufacturing Standard
 - a BS EN 60702-1
- 8 COP/Guide to Use
 - a BS 5839-1 Clause 26.2e Enhanced

- b BS 5266
- c BS 8519 Category 1 & 2 Control
(for Category 3 & power applications see special notes)
- 9 Fire Tests:
 - a BS 8434-2
 - b BS EN 50200 PH30, PH60, PH120
 - c BS 6387 C W & Z
 - d BS 8491
- 10 Emissions and Flame Propagation:
 - a BS EN 50267 (IEC 60754) Acid Gas Emission
 - b BS EN 50268 (IEC 61034) Smoke Emission
 - c BS EN 50265, 50266 (IEC 60332) Flame Propagation

Y61.2.10 BS EN 50525-3-21 HOFR TRAILING FLEXIBLE CABLE

- A Applications: Heat and oil resistant cables. Flexible rubber cable suitable for most industrial applications and in domestic situations for hot situations such as immersion heaters.
- 1 Voltage Rating: 450/750V
 - 2 Manufacturer/Supplier:
 - a Eland Cables
 - b Cleveland Cable Company
 - c Batt Cables
 - 3 Construction:
 - a Class 5 tinned flexible copper conductors sizes:
 - 1 core: 4mm² to 16mm²
 - 2 core: 4mm² to 16 mm²
 - 3 core: 4mm² to 16 mm²
 - 4 core: 4mm² to 16 mm²
 - b insulation. EPR (Ethylene propylene rubber)
 - c Sheath:
 - CSP (Chlorosulphonated polyethylene)
 - HOFR (Heat & oil resistant & flame retardant)
 - 4 Operating Temperature: -20°C to +90°C
 - 5 Minimum Bending Radius:
 - a Cables Fixed: 6 x overall diameter
 - b Cables Flexing: 7x overall diameter
 - 6 Sheath Colour: Black
 - 7 Manufacturing Standard
 - a BS 7919
 - 8 Fire Tests:
 - a BS EN 50265-2-1 (BS EN 60332-1-3: Flame retardant)

Y61.2.11 BS 7629-1 FIRE RESISTANT ALARM AND EMERGENCY LIGHTING CABLE “STANDARD”

- A Applications: Standard cable is suitable for fire alarm systems, emergency lighting and BS 5839-8 voice alarm systems. It meets the standard grade of BS 5839 26.2d & Category 1 Control as defined by BS8519.
- 1 Voltage rating: 300/500V
 - 2 Manufacturers:
 - a AEI: Firetec standard
 - b Prysmian: FP 200 Gold
 - c Draka: FT30 Saffire
 - 3 Approvals:
 - a BASEC

- b LPCB
 - c LUL1-85 (if additionally required)
- 4 Construction: Solid or stranded plain annealed copper conductors. BS EN 60228 Class 1 or 2
 - a Tinned annealed copper full size CPC.
 - b Fire screen:
 - Firetec: Aluminium/polyester laminated tape screen.
 - FT 200: Insulite to BSEN 50363-5 E15 or
 - FT30: Durolate
 - c LSZH/LS0H insulation and outer sheath.
- 5 Sizes:
 - a 2 core: 1.5mm² to 4.0 mm²
 - b 3 core: 1.5mm² to 4.0mm²
 - c 4 core: 1.5mm² to 4.0 mm²
- 6 Minimum Bending Radius: 6 x overall diameter
- 7 Core Identification:
 - a 2 core Bn, Be
 - b 3 core Bn, Bk, Gy
 - c 4 core Bn, Bk, Gy, Be
- 8 Sheath Colour: Red or White.
- 9 Manufacturing Standard: BS 7629-1
- 10 Code of Practice/Guide to Use: (refer to table)
 - a BS 5839-1 Clause 26.2d Standard
 - b BS5839-8 (
 - c BS 5266
 - d BS 8519 Category 1 Control
- 11 Fire Tests
 - a BS7629-1: STANDARD 60
 - b BS EN 50200:
 - PH30, PH60, FP 200 Gold
 - PH30, PH60, PH120 Firetec, Fire Tuf 30
 - c BS 6387: C W & Z
- 12 Emissions and Flame Propagation
 - a BS EN 60754 (BS EN 50267) Acid Gas Emission
 - b BS EN 61034-2 (BS EN 50268) Smoke Emission
 - c BS EN 60332-1-2 (BS EN 50265,50266) Flame Propagation

Y61.2.12 BS 7629-1 FIRE RESISTANT ALARM AND EMERGENCY LIGHTING CABLE “ENHANCED”

- A Applications: Enhanced cable is suitable for fire alarm systems, BS 5839-8 voice alarm systems and BS5266-1 emergency lighting circuits & Category 1, 2 & 3 Control circuits as defined in BS8519. The mica glass tape is applied directly over the conductor to ensure the best possible enhanced fire performance. It meets enhanced grade as defined by BS5839-1 26.2e. (refer to table for different manufacturer's standards)

- 1 Voltage rating: 300/500V
- 2 Manufacturers:
 - a Prysmian: FP Plus
 - b AEI: Firetec enhanced
 - c Draka: FireTuf FT120 enhanced
- 2 Approvals:
 - a BASEC
 - b LPCB
 - c LUL 1-85 (if additionally required)
- 3 Construction: Solid or stranded plain annealed copper conductors. BS EN 60228 class 1 or 2
 - a Tinned annealed copper full size CPC.

- b Insulation:
 - Firetec:Mica/glass fire barrier tape
 - FP Plus: Insulite to BSEN 50363-5 E15 + mica tape
 - FireTuf enhanced: Mica/glass fire barrier tape
- c Screen:
 - Aluminium/polyester laminated tape screen.
 - Collective Aluminium Mylar
- d LSZH/LS0H insulation and outer sheath.
- 4 Sizes:
 - a 2 core: 1.5mm² to 4.0 mm²
 - b 3 core: 1.5mm² to 4.0mm²
 - c 4 core: 1.5mm² to 4.0 mm²
- 5 Minimum Bending Radius: 6 x overall diameter
- 6 Core Identification:
 - a 2 core Bn, Be
 - b 3 core Bn, Bk, Gy
 - c 4 core Bn, Bk, Gy, Be
- 7 Sheath Colour: Red or White.
- 8 Manufacturing Standard: BS 7629-1
- 9 Code of Practice/Guide to Use:
 - a BS 5839-1 Clause 26.2e Enhanced
 - b BS5839-8 (except FireTuf)
 - c BS 5266 (Except Fire Tuf)
 - d BS 8519 Category 1 & 2 Control (Except Fire Tuf)
 - e Some manufacturers suitable for Cat 3 control
- 10 Fire Tests
 - a BS7629-1: ENHANCED 120
 - b BS 8434-2
 - c BS EN 50200: PH30, PH60, PH120
 - d BS 6387: C W & Z
- 11 Emissions and Flame Propagation
 - a BS EN 60754 (BS EN 50267) Acid Gas Emission
 - b BS EN 61034-2 (BS EN 50268) Smoke Emission
- 12 BS EN 60332-1-2 (BS EN 50265,50266) Flame Propagation

Y61.2.13 BS 7629-1 FIRE RESISTANT VOICE ALARM “STANDARD” & “ENHANCED”

A Applications: Enhanced cable is suitable for fire alarm systems, BS 5839-8 voice alarm systems and BS5266-1 emergency lighting circuits & Category 1, 2 & 3 Control circuits as defined in BS8519. The mica glass tape is applied directly over the conductor to ensure the best possible enhanced fire performance. It meets enhanced grade as defined by BS5839-1 26.2e. (refer to table for different manufacturer's standards)

- 3 Voltage rating: 300/500V
- 4 Manufacturers: Enhanced
 - a Prysmian: FP Plus
- 2 Manufacturers: Standard
 - a Prysmian: FP200 Gold
 - b AEI: Firetec standard
 - c AEI: Firetec; enhanced
- 3 Approvals:
 - a BASEC
 - b LPCB
 - c LUL 1-85 (if additionally required)
- 4 Construction: Solid or stranded plain annealed copper conductors. BS EN 60228 class 1 or 2

- a Tinned annealed copper full size CPC.
- b Insulation:
 - Firetec:Mica/glass fire barrier tape
 - FP Plus: Insulite to BSEN 50363-5 E15 + mica tape
- c Screen:
 - Aluminium/polyester laminated tape screen.
- d LSZH/LS0H insulation and outer sheath.
- 5 Sizes:
 - a 2 core: 1.5mm² to 4.0 mm²
 - b 3 core: 1.5mm² to 4.0mm²
 - c 4 core: 1.5mm² to 4.0 mm²
- 6 Minimum Bending Radius: 6 x overall diameter
- 7 Core Identification:
 - a 2 core Bn, Be
 - b 3 core Bn, Bk, Gy
 - c 4 core Bn, Bk, Gy, Be
- 8 Sheath Colour: Red or White.
- 9 Manufacturing Standard: BS 7629-1
- 10 Code of Practice/Guide to Use:
 - a BS 5839-1 Clause 26.2e Enhanced
 - b BS5839-8
 - c BS 5266
 - d BS 8519 Category 1 &2 Control
 - e Some manufacturers suitable for Cat 3 control
- 11 Fire Tests
 - a BS7629-1: ENHANCED 120
 - b BS EN 50200: PH30, PH60, PH120
 - c BS 6387: C W & Z
- 12 Emissions and Flame Propagation
 - a BS EN 60754 (BS EN 50267) Acid Gas Emission
 - b BS EN 61034-2 (BS EN 50268) Smoke Emission
 - c BS EN 60332-1-2 (BS EN 50265,50266) Flame Propagation

Y61.2.14 BS 7846 FIRE RESISTANT ARMoured POWER CABLE

- A Application: Fire resistant armoured cable suitable for use in fixed installations for power circuits, fire alarm systems & emergency lighting systems. It is robust, flexible and suitable for use inside and outside buildings, meeting the enhanced grade of BS5839 26.2e.
- 1 Voltage rating: 600/1000 V
 - 2 Manufacturers:
 - a Prysmian FP 600S
 - b AEI: Firetec Power
 - c Draka: FTP 120 Enhanced
 - 3 Approvals:
 - a BASEC
 - b LPCB
 - c LUL 1-85 (if additionally required)
 - 4 Construction: Stranded plain annealed copper conductors.
 - a Mica/glass fire barrier tape.
 - b Cross linked polyethylene insulation (XLPE).
 - c LSZH/LS0H/0HLS bedding,
 - d steel wire armouring
 - e LSZH/LS0H/0HLS outer sheath.

- 5 Sizes:
 - a 2 core: 1.5mm² or 4 to 400mm²
 - b 3 core: 1.5mm² or 4 to 400mm²
 - c 4 core: 1.5 mm² or 4 to 400 mm²
- 6 Minimum Bending Radius: 6 x overall diameter
- 7 Core Identification:
 - a 2 core Bn, Be
 - b 3 core Bn, Bk, Gy
 - c 4 core Bn, Bk, Gy, Be
- 8 Sheath Colour: Black.
- 9 Manufacturing Standard: BS 7846
- 10 Code of Practice/Guide to Use:
 - a BS 5266
 - b Some manufacturers:
 - BS 8519 category 1,2 &3 Control
 - BS 5839 26.2 e Enhanced
- 11 Fire Tests
 - a BS 6387 C W & Z
 - b BS 7846 F2 or F120
 - c BS 8434-2
 - d BS EN 50200 PH30, PH60, PH120
- 12 Emissions and Flame Propagation
 - a LUL 1-85 (if required)
 - b BS EN 50267 (IEC 60754) Acid Gas Emission
 - c BS EN 50268 (IEC 61034) Smoke Emission
 - d BS EN 50265, BS EN 50266 (IEC 60332) Flame Propagation

Y61.2.15 BS 7846 FIRE RESISTANT IMPACT POWER CABLE

A Application: Impact Power cables are similar in construction to armoured cables but provide additional protection to smaller cable sizes to ensure the best possible mechanical protection from a polymeric cable. Designed to meet the application of fire, direct impact and water jet as specified in BS8491, making them suitable for use as 120-minute rated category 3 power cables under BS8519.

- 1 Voltage rating: 600/1000 V
- 2 Manufacturers:
 - a Prysmian: FP600S
 - b AEI: Firetec Impact power
- 3 Approvals:
 - c BASEC
 - d LPCB
 - e LUL 1-85 (if additionally required)
- 4 Construction: Stranded plain annealed copper conductors.
 - a Mica/glass fire barrier tape.
 - b Cross linked polyethylene insulation (XLPE).
 - c LSZH bedding,
 - d steel wire armouring
 - e LSZH outer sheath.
- 5 Sizes:
 - f 2 core: 4.0mm² to 400mm²
 - g 3 core: 4.0mm² to 400mm²
 - h 4 core: 4.0mm² to 400 mm²
- 6 Minimum Bending Radius: 8 x overall diameter
- 7 Core Identification:

- i 2 core Bn, Be
- j 3 core Bn, Bk, Gy
- k 4 core Bn, Bk, Gy, Be
- 8 Sheath Colour: Black.
- 9 Manufacturing Standard: BS 7846 F120
- 10 Code of Practice/Guide to Use:
 - l BS 8519 Category
 - Control: 1 & 2 & 3
 - Power: 1 & 2 & 3
 - b BS 9999
- 11 Fire Tests
 - m BS 8434-2
 - n BS 6387: C W & Z
 - o BS 8491
- 12 Emissions and Flame Propagation
 - e LUL 1-85 (if required)
 - f BS EN 50267 (IEC 60754) Acid Gas Emission
 - g BS EN 50268 (IEC 61034) Smoke Emission
 - h BS EN 50265 (IEC 60332) Flame Propagation

Y61.2.16 BSEN 50525-3-11 H0Z1Z1-F FLEXIBLE POWER AND LIGHTING FINAL CONNECTIONS

- A Application: Used as an indoor general wiring cable primarily for installations in public areas. Examples include use on pendant lighting drops or as a general supply lead within hospital or airport projects. For installation where fire, smoke emission and toxic fumes create a potential risk to life and equipment
- 1 Voltage rating: 300/500 V
 - 2 Manufacturers:
 - a Eland Cables: A5Z
 - b Batt: 318B
 - c Cleveland Cable company
 - 3 Approvals:
 - a BSI
 - 4 Construction: Class 5 flexible copper conductor: BS 60228.
 - a Insulation: LSZH Type T16: BS EN 50363
 - b LSZH outer sheath. Type TM7: BS EN 50363
 - 5 Sizes:
 - b 2 core: 1.0mm² to 4 mm²
 - c 3 core: 1.0mm² to 4 mm²
 - d 4 core: 1.0mm² to 4 mm²
 - e 5 core: 1.0mm² to 4 mm²
 - 6 Minimum Bending Radius 5 x overall diameter
 - 7 Core Identification:
 - a 2 core Bn, Be
 - b 3 core Green/yellow, Bn, Be
 - c 4 core Green/yellow, Bn, Bk, Gy
 - d 5 core Green/yellow, Bn, Bk, Gy, Be
 - 8 Sheath Colour:
 - a Power: Black (unless advised otherwise)
 - b Lighting: white
 - 9 Manufacturing Standard:
 - a BS EN 50525-3-11
 - b BS EN 60228
 - 10 Fire Tests

- a BS EN 50363
- b BS EN 50525-3-11
- 11 Emissions and Flame Propagation
 - a BS EN/IEC 60332-1-2 Flame Propagation
 - b BS EN 61034-2 Smoke density

Y61.2.17 LOW/HIGH VOLTAGE CABLES (SUPPORT SYSTEMS)

- A Unless otherwise indicated, the type of cable supports used shall be selected by the Contractor to suit the circumstances of the installation and shall be approved by the Engineer. The following preferences shall be taken into account:
- 1 LV & HV sub mains: Cable ladder rack
 - 2 LV horizontal runs: Cable tray.
 - 3 LV vertical runs: Cable cleats or cable tray.
(use 2-piece aluminium type for cables $\geq 70\text{mm}^2$)
 - 4 Where marshalling of cables Occur, e.g. at switchboards. Cable ladder racks.
- B **Cable cleat:** Install at recommended spacing along lengths of cables in order to provide resistance to electromechanical force. Cleats are attached to the mounting surface.
- C **Intermediate restraint:** installed together with cable cleats to hold the cables together in order to provide resistance to electromechanical forces. Intermediate restraints are not attached to the mounting surface
- D For details of containment and supports refer to
- 1 Y60: Conduits and Trunking
 - 2 Y63: Cable Supports.
 - 3 Y90: Fixing to Building Fabric

Y61.2.18 LOW VOLTAGE EMERGENCY SYSTEM CABLES (SUPPORT SYSTEMS)

- A Single core cables: Route in dedicated steel conduits.
- B Multicore cables: Provide cables with fire resistance and run on trays, trunking and basket. Provide segregation for appropriate services as noted elsewhere.

Y61.2.19 ELV CABLING FOR IT SERVICES (SUPPORT SYSTEMS)

- A Single core cables: Route in dedicated steel conduits.
- A Multicore cables: Provide segregation for appropriate services as noted elsewhere.
- 1 **Perforated Cable tray:** Use for applications where some physical strength is required typically where system is exposed to view including Data, shorter spans and medium loads and medium heat producing cables
 - 2 **Cable basket:** Use for BMS, Data, Voice, Lighting control and Comms installations in false ceilings and raised floor where greater ventilation is required. Spans are shorter and lighter loading. Physical protection is limited
 - 3 **Cable trunking:** Use for single cables, Data, Comms, security, and BMS cables. Spans short and lighter loading. Refer to section Y60

Y61.2.20 SLEEVES FOR CABLES

- A Provide metallic or PVC sleeves for all cables passing through walls or floors.: Refer to electrical standard detail drawings and part 3 of this specification.

- B Fire rated walls and floors: Where cables pass through internal divisions in the building fabric which are constructed as fire barriers, the sleeves fitted should be fire sleeves as required by the Building Regulations or for health care premises by NHS Firecode (Health technical memorandum 05-01,02,03). Refer to Y63.3.13 for:
- 1 Intumescent pillows
 - 2 Trunking and tray compressible fire stop batts
 - 3 Multi-cable transits
 - 4 Intumescent conduits
- C Refer also to electrical standard details and part 3 of this specification for installation details.

Y61.2.21 SLEEVE SEALS

- A Provide modular sealing device, designed for field assembly, to fill annular space between sleeve and cable. Refer to standard electrical details.
- B Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of conduit.
- C Pressure Plates: Carbon steel or Stainless steel. Include two for each sealing element.
- D Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

Y61.3 PART 3 – EXECUTION

Y61.3.1 PREPARATION

- A Support all cables throughout their length using conduit; or trunking and enclosures; or cable tray; or cable racking; or special support systems; or cleat or clip fixing direct to building fabric as indicated on the drawings / schedules.
- B For the installation of conduits, trunking and cable trays and ladder racks comply with the guidance in the following specification sections:
 - 1 Y60: Conduit & Trunking
 - 2 Y63: Cable support
- C Prior to installing cable on the tray or ladder, examine the cable paths to ensure all areas are free of debris that may interfere with the cable's installation. Ensure that surface areas of tray or ladder components likely to come into contact with cables do not cause damage to the cables when installed according to the manufacture's instruction or this specification.
- D Ensure that all the materials used to support the cables are suitable for the environment into which they are to be installed.
- E Install the cable tray system according to the coordination drawings and the tray manufacturer's assembly and installation instructions.
- F Life Safety and firefighting cables: Check that:
 - 1 Proposed primary and secondary supply routes are adequately separated and diverse.
 - 2 Cables are routed on dedicated containment systems

Y61.3.2 CABLE DELIVERY AND STORAGE

- A Deliver, off load including craneage and store cables on site on the manufacturer's drums/reels/coils. Ensure cables on drums are of substantial construction with the centre hole reinforced, two non-deteriorating indestructible labels are fixed to each drum, one inside and one outside the drum flange.
- A Ensure all cables are new with each coil, drum or reel having its seal intact and having the following information indicated:
 - 1 Manufacturer's name.
 - 2 Size,
 - 3 number of conductors,
 - 4 voltage grade,
 - 5 type of cable,
 - 6 classification.
 - 7 Length in metres on drum/reel/coil.
 - 8 Gross weight (where applicable).
 - 9 Order number.
- B Ensure all cables are by the same manufacturer, where possible, for each particular project and installation.
- C Deliver and store cables to manufacturer's recommendations with the ends sealed to prevent ingress of moisture and escape of insulation or impregnation.

Y61.3.3 CABLE ROUTES AND SERVICE CLEARANCES

- A Unless the routes of cables are indicated on the drawings, they shall be determined by the Contractor and approved by the CA before work is started.

- B A minimum clearance of 150mm shall be allowed from any equipment, pipework or ductwork; the distance shall be measured from the external surface of any lagging. In the event of difficulty in achieving these requirements, the CA shall be informed.

Y61.3.4 CABLE INSTALLATION GENERAL

- A Use only suitably trained and qualified operatives to carry out the installation in accordance with IET wiring regulations.
- B The method of cable installation will depend on a number of factors, such as:
- 1 type of cables selected,
 - 2 location,
 - 3 environmental factors/conditions,
 - 4 aesthetics
- C Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- D Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- E Identify and colour-code conductors and cables according to V80 Electrical Identification.
- F Do not handle or install cables when the temperature is below 0°C. Allow a minimum period of 24 hours before cables are used if the cables have been exposed to such temperatures.
- G Run cables from the tops of their drums, with supporting ramps if necessary, the drums being braked to avoid over running.
- H Do not impose stress on cables by twisting or stretching forces. Allowance shall be made for expansion joints in large buildings and structures.
- I Lay multiple cable runs so that minimal crossing of cables occurs.
- J Do not exceed minimum bending radii for each cable type, size, installation arrangement and detail.
- K If the cable is damaged in any way during installation, it must be made good or replaced
- L Ensure conductor sizes to any cables are designed and installed not less than 1.5mm², except for flexible cords with minimum conductor size of 0.75mm², or where other minimum conductor sizes are indicated on the particular project drawings or in the Specification.
- M Cable ends cut on site which are not to be terminated immediately should be sealed. Ensure all cable ends are sealed upon completion of tests.
- N Where cables and containment are installed in or above fire escape fix to the building fabric using metallic, corrosion resistant, non-combustible fixings, cleats or ties.
- O Use overhead lines only where specifically necessary for the particular project requirements, and only following agreement with the CA.
- P Use cable sheath and core colours where identified in the Specification and also identification as given in the relevant Standards.
- Q Design/install cable routes and locations where possible at high level so as to be beyond the reach of people and moving equipment. Ensure that cables, trays, ladders, trunkings, baskets and other containment systems are accessible once installed.

Y61.3.5 PULLING OF CABLES

- A Where cables are large or cable runs are long, their installation may require pulling tools in such cases the following is recommended:

- 1 On horizontal straight runs, the cables to ride on rollers mounted in or on the cable tray or cable ladder. These rollers should be properly spaced dependent on the size and weight of the cable to prevent the cable from sagging and dragging in the cable tray or cable ladder during the pull
 - 2 Contact the cable manufacturer for information regarding proper roller spacing
 - 3 On horizontal bends and vertical pulls, the cables are to run through rollers or pulleys to maintain a minimum bending radius. Rollers and pulleys must be of sufficient diameter to prevent pinching the cable between the roller/ pulley flanges. Each cable will have a minimum bending radius that must be maintained to prevent damage to the cable
 - 4 Due to the length of some cable pulls and the cable weight, a great deal of force can be applied to the pulleys on horizontal and vertical bends. These pulleys should be anchored to the structural steel and not to the cable tray or cable ladder due to the force that can be applied during pulling. Do not pull down on the horizontal rollers, as they are not designed for this purpose, and damage could result to the cable, cable tray or cable ladder.
- B Use manufacturer approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Comply with manufacturer's instructions and particularly for:
- 1 maximum pulling tensions and sidewall pressure values.
 - 2 co-axial cables maximum bending radius: 6 x overall diameter.
- C Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or conduits.

Y61.3.6 INSTALLATION OF CABLES ON TRAYS AND BASKETS

- A For installation of trays, racks and baskets refer to section Y65 of this specification
- B Install cables only when the cable support installation is complete and inspected.
- C Cables should be fastened to the cable ladder and/or cable tray using correctly sized cable cleats or cable ties to prevent movement of the cables under normal use and during fault conditions. Generally, the spacing between cable fastenings should not exceed the dimensions stated in BS 7671 and as indicated in table below.
- D For applications where the fault current level requires it, spacing between cable fastenings may be less than those indicated. Where this applies details should be obtained from the electrical supplier of the fastenings.

Table 3: Maximum Spacing of Cable Fastenings

Maximum spacing of cable fastenings mm						
Overall diameter or max width of cable	Non- armoured thermosetting or thermoplastic sheathed cables		Armoured Cables		Mineral Insulated copper or aluminium sheathed cables	
mm	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
≤9	250	400	-	-	600	800
>9≤15	300	400	350	450	900	1200
>15≤20	350	450	400	550	1500	2000
>20≤40	400	550	450	600	-	-

- E For the spacing of supports for cables having an overall diameter exceeding 40 mm, the manufacturer's recommendation should be observed.
- F Cable cleats and cable ties should be correctly sized and only tightened enough to secure the cable without indenting the insulation sheath.
- G On vertical runs the fastenings must be able to withstand the forces exerted by the weight of the cable. The cable weight should be supported in such a manner as to prevent damage to the cable ladder, cable tray or cable. Use 2 piece aluminium cleats for cables $\geq 40\text{mm}$ OD.
- H Where possible it is best practice to position cable cleats on alternate rungs of the cable ladder in order to evenly spread the load along the length of the cable ladder.
- I For cables on horizontal tray use ties for each circuit. Use tie manufacturer's special tensioning tool where available. Crop off tie ends.
- J The following table indicates the maximum clamping capacity of various widths/lengths of cable tie

Table 4: Maximum Clamping Capacity of Various Widths/Lengths of Cable Tie

Maximum clamping diameter	2.5mm wide	3.6mm wide	4.8mm wide	7.6mm wide	9mm wide
mm	Cable Tie Length mm				
18	100				
30	120	140			
35		150			
40	200		188		
50		200	200		
60			250		
76		295	300	297	
102		370	368	368	
120					430
140					530
228					775

- K Install cable cleats according to manufacturer's guidelines and comply with the following:
- 1 Cable cleats should always be installed at the beginning, middle and end of a bend, and at no time should the distance between cleats on a bend be more than 0.3m centre to centre
 - 2 It is not necessary for every cleat to be attached to the tray. Every other cleat must be attached to the tray system to mount cable in tray. Unattached cleats provide additional restraint to keep cables bundled
 - 3 Cable bend radius should be 8 to 12 times the cable diameter.

- L Except for cables in trefoil encapsulation and control cables, all cables are to be installed, on horizontal cable trays one layer deep
- M Ensure cables at low level in accessible or vulnerable positions, particularly where rising from the floor, have additional mechanical protection. For vertical surface mounted cables this is to comprise earthed steel pipe or channel up to a height of 3 metres above floor level or as otherwise dictated by the location.
- N Protect cables passing through walls with tubular sleeves set into the wall. Finish sleeve ends flush with the wall finish, with rounded edges to avoid damage to the cable sheath when drawn through. Ensure the sleeves are of adequate bore to enable easy cable drawing and packed with approved fire-resistant material after cable installation.
- O Protect all fixing cleats, cable tray and associated nuts, screws, bolts and frameworks against corrosion.
- P Apply additional de-rating factors for design and installation of externally exposed cables, where effects of solar heat gain will occur. Provide shading and/or additional containment where cables are susceptible to damage from ultraviolet light.
- Q Provide manufacturers works test certificates as required in the relevant British Standard for all cable types and specifications installed, in addition to installation test certificates and schedules required in the Specification.
- R In the event of any damage occurring to cables while in store, installation or during testing, remove and replace the whole of the cable length.
- S Measure actual cable route lengths to ensure correct and continuous lengths are delivered. No joints will be accepted without prior agreement with CA.

Y61.3.7 INSTALLATION OF CABLES IN CONDUITS AND TRUNKING

- A Comply with the requirements of BS7671 and associated Guidance Notes.
- B Segregate circuits as indicated.
- C Ensure draw wires are left within empty conduits for use of specialist installers. Use draw wires comprising nylon tapes with fitted eyelets.
- D For concealed conduit ensure system is installed to enable re-wiring to be carried out from boxes for fittings or accessories only. Draw-in boxes will only be permitted with prior permission in writing.
- E Do not use tallow or any other substances to facilitate drawing-in of cables.

Y61.3.8 DATA CABLES & SEGREGATION

- A Installation: There are rules that apply to the installation of all data cable bundles, regardless of containment type, and they are:
 - 1 Cable ties must not be too tight. Any cable within a tied bundle must be able to be moved through that tie with slight resistance
 - 2 Data and optical cables cannot stand the same heavy-duty 'lashing' as power cables. The tie must not be too thin as it may cut into the sheath of the cable
 - 3 The minimum bend radius shall not be less than that specified by the cable manufacturer
 - 4 Manufacturers generally specify six to eight times the cable diameter as the cable bend radius.
 - 5 There is no exact or correct figure for the amount of cables allowed in any one bundle, typically a figure of between 24 and 48 cables is used.
- B Segregation: Where power and data cables are installed within the same containment system or within close proximity to each other, suitable segregation shall be used. Comply with guidance in BS 6701 and BS EN 50174.

Y61.3.9 EXPANSION

- A Cater for structural building and thermal movements with the application of expansion joints in cable trays/ladders. Use expansion couplers spaced to accommodate the maximum temperature differential which is likely to be encountered in the installation.
- B Where expansion joints are present in the cable tray or cable ladder installation, provision must be made for the cable to expand and contract correspondingly. This is usually achieved with a loop in the cable at the expansion joint position.

Y61.3.10 EARTHING

- A Provide earthing to cable trays and bond each section together with proprietary earthing loops in accordance with BS 7671.
- B Ensure metal framework of equipment is bonded to main earth point. Ensure that cable CPC's are connected to earth bar.
- C Provide earth CPC between earth lug on metal box and accessory casing except where accessory is encased in plastic.

Y61.3.11 TERMINATIONS

- A Ensure that termination components are suitable for the environment into which they are installed.
- B Do not use soldered connections or lugs. Terminate all conductors requiring bolted connections with compression lugs using automatic compression crimp tools which will only release after the correct crimp depth has been obtained. Use spring washers on all bolted connections.
- C Make terminations that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unjointed conductors.
- D Ensure all conductor terminations are made by compression joints.
- E Where it is necessary to apply additional protection, sleeves use the correct colour coded PVC insulation tape wrap bound to the thickness of the original conductor insulation. Heat shrink-on sleeves are acceptable.
- F Ensure
 - 1 correct phasing out of all cores prior to the commencement of connections.
 - 2 all bolted terminations have suitable bolts, nuts and shakeproof washers, adjusted to the correct torque.
 - 3 Connections of the pinch screw type are not permitted, other than in final small power and lighting circuits.
 - 4 adequate protection from all weather conditions for exterior work.
 - 5 terminations, glands, sealing boxes, etc. do not transmit stress onto switchgear from adjacent bends in the cables.
 - 6 metal glands are protected by LSOH shrouds of same colour as the cable sheath.
 - 7 suitable measures are taken to prevent circulating current in switchgear metalwork caused by individual conductors.
 - 8 cable joints and terminations are suitable and fully compatible with the switchgear and/or equipment and manufacturers requirements
 - 9 Use of oxide inhibitor in each joint conductor for aluminium conductors.
- G All armoured cables to be terminated with earth tags and with connected earth cabling to maintain earth integrity.
- H Provide for conductor terminations of a suitable type and size for the equipment terminals to which the cables are connected.

- I Include glands and joints having suitable accessories for earthing of armour and sheaths as detailed in the Specification.
- J Provide copper bonds within the joint to maintain full earth continuity. Ensure the resistance is no greater than that of the live conductors and the insulation resistance between cores, and between cores and earth, is no less than that of the original cable.
- K Ensure, where jointing to switchgear, and equipment, that for phases, when viewed from the front of the switchgear, the brown / red phase is on the left, black or yellow phase is in the centre and grey / blue phase is on the right.
- L Carry out tests upon completion of all cable joints and terminations in accordance with the Specification including phase rotation tests where applicable.
- M Wiring at Outlets: Install conductor at each outlet, with at least 150 mm of slack.

Y61.3.12 JOINTING CABLES

- A No joints are permitted unless approved by the CA. Provide manufacturer's approved detail and method statement for joining cables. Where use of joints is agreed and for cable terminations:
 - 1 Use skilled craftsmen fully experienced in terminating and jointing the types of cable specified.
 - 2 For HV cables specify and/or use a suitably experienced company approved by CA.
- B Make all cable joints using a proprietary system supplied by one manufacturer and install strictly in accordance with their instructions for each particular cable type.
- C Carry out each termination or joint to completion without interruption
- D Do not cut cable until the jointing or terminating commences and the work is able to proceed continuously until it is completed. Take all necessary precautions to prevent damage and ingress of moisture and impurities. Ensure cable ends are free from moisture before jointing commences. Where circumstances prevent completion seal the cable ends.
- E For joints in armoured cables, bonding conductors shall be connected across the armouring. A split ferrule shall be placed under the armouring to prevent deformation of the cable by the clamp. Joints shall only be made using cable jointing kits from the same manufacturer as the cable. They shall be strictly in accordance with the manufacturer's instructions.
- F At terminations, cable armouring and metal sheaths shall be connected directly to the external earthing terminal of the equipment by a bonding conductor. For L.V. cables, the bonding conductor shall have cross sectional area in accordance with regulations mentioned elsewhere in this specification.
- G At all terminations, cable tails shall be formed by separating and bringing out each of the cores. Each tail shall be long enough to connect to the terminals or the equipment.
- H Core identification at terminations shall be by coloured or numbered plastic stretch or shrink ferrules.
- I Continuity of spare cores shall be maintained at joints, and at terminations the cores shall be connected to spare terminals.
- J Compression connectors and associated dies for the compression tool shall be the correct type and size. The tool shall be so designed that the correct compression must be applied before it can be released.

Y61.3.13 SUB-CIRCUIT WIRING - LIGHTING

- A Install lighting wiring within trunking, conduit or a combination of both or lighting busbar systems. For containment installation refer to:
 - 1 Y60: Conduit & Trunking and
 - 2 Y63: Cable support

3 V33: Busbar trunking

- B Construction: For normal applications use galvanised steel containment but refer also to above sections for alternative materials that should be used in special areas or where required by section B of this specification.
- 1 Minimum conductor size: 2.5mm^2 (consideration may be given to 1.5mm^2 with approval of CA)
- C Generally, the lighting installations in all public and non-public areas shall be controlled via the lighting control system; refer to:
- 1 V50: Lighting Systems
2 V51: Automatic Lighting Controls
3 V59: General luminaires and lamps
- D Wire each lighting circuit as shown on the drawings and in accordance with this specification. Generally, luminaire terminations to be:
- 1 Luminaires within suspended ceilings: Use a plug-in socket or ceiling rose and flexible cord.
2 Suspended luminaires: Use a ceiling rose (rock rose)
3 Luminaires mounted direct to conduit termination: use a terminal block in the conduit box.
4 External luminaires: Use armoured cabling and provide weatherproof loop in boxes
- E Earthing: Provide a protective conductor to connect the earthing terminal or earthing contact of each luminaire to a means of earthing incorporated in the adjacent conduit box. Where the final connection is by flexible cord the protective conductor forms part of the cord.
- F Ensure that cables and flexible cords for final connections to luminaires are suitable for the operating temperature of the luminaire. Provide white flexible cords for all suspended luminaires unless otherwise indicated.
- G Ensure that cables and cords passing close to a ballast within a luminaire are suitable for the operating temperature of the ballast. Provide heat resisting sleeves where necessary.

Y61.3.14 SUB-CIRCUIT WIRING - SMALL POWER

- A Install small power wiring within trunking or conduits or use may be made of wall mounted or underfloor busbar systems. Refer to the drawing and comply with the following specification sections:
- 1 Y60: Conduit & Trunking (including perimeter and underfloor trunking)
2 Y63: Cable support
3 V33: Busbar trunking
- B Construction: For normal applications use galvanised steel containment but refer also to above sections for alternative materials that should be used in special areas or where required by section B of this specification.
- 1 Minimum conductor size: 2.5 mm^2
2 Under floor modular busbar systems refer to V40
- C The specific requirements are indicated on the drawings and as indicated in section B of the specification.

Y61.3.15 SUB-CIRCUIT WIRING - APPLIANCES AND MOTORS (SINGLE AND 3 PHASE)

- A Install power wiring to appliances and motors within trunking or conduits. Refer to the drawings and comply with the following specification sections:
- 1 Y60: Conduit & Trunking
2 Y63: Cable support
3 Y60.2.6: Flexible metal conduit

- B When connecting to vibrating equipment ensure that the cable and conduit is flexible and allows sufficient movement to accommodate the movement of the equipment.
- C For connection to appliances, which may require to be moved for maintenance or cleaning ensure that the flexible cord is adequate in length but not longer than 1.5m.
- D Locate switches or fused connectors, for appliances and motors a maximum of 1.5m from appliances except where otherwise indicated on the drawings.

Y61.3.16 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A Co-ordinate sleeve selection and application and provide fire-stopping in fire rated walls and floors. Refer to standard details and Y63.3.12 and Y63.3.13. Use sleeves of the following types:
 - 1 Galvanised steel pipe sleeves for metal conduits
 - 2 PVC sleeves for plastic conduits or insulated cables
 - 3 Rectangular metal sleeves for cable trays/ladder racks and baskets.
- B Use proprietary systems (Y63.3.13) for penetrations through fire walls and floors. Apply fire stopping in accordance with manufacturers details.

Y61.3.17 SLEEVE-SEAL INSTALLATION

- A Use proprietary systems to seal underground exterior-wall penetrations.
- B Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in centre of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Y61.3.18 UNDERGROUND CABLES IN TRENCHES AND DUCTS

- A Comply with the requirements of section P30 of this specification including:
 - 1 Excavating and Preparation of trenches
 - 2 Types of ducts for ducted services
 - 3 Bedding and backfilling materials
 - 4 Warning marker tapes
 - 5 Access chambers and pits
 - 6 Routing
 - 7 Segregation of services
 - 8 Special precautions for contaminated ground
- B Cross over of cables is only permitted at junctions. Maintain clearances between the cables at cross overs. Do not lay cables one above the other except where indicated.
- C If more than one cable is to be drawn in a duct, bunch the cables together and pull in one operation, wherever possible.
- D Comply with P30 for installation of identification tapes, meshes or tiles along the routes of services.

Y61.1.1 IDENTIFICATION

- A Comply with V80 "Electrical Identification".

Y61.3.19 FIELD QUALITY CONTROL

- A After installing cable supports and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:
- 1 Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable supports, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage
 - 2 Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by BS 7671 + A3.
 - 3 Verify that communication or data-processing circuits are separated from power circuits by barriers
 - 4 Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables
 - 5 Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation
 - 6 Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and re-torque in suspect areas
 - 7 Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware
 - 8 Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all take-off raceways are bonded to cable tray.
 - 9 Report results in writing.
- B Perform tests and inspections and prepare test reports as required by:
- 1 Specification Section Y50: Testing and Commissioning of Mechanical and Electrical services
 - 2 IET wiring regulations
 - 3 Test Instruments: Use instruments that comply with BS7671+A3.
- C Test Reports: Prepare a written report to record the following:
- 1 Test procedures used
 - 2 Test results that comply with requirements
 - 3 Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D Remove and replace malfunctioning units and retest as specified above.

Y63 CABLE SUPPORTS

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Y63.1 PART 1- GENERAL

Y63.1.1 RELATED DOCUMENTS

- A Drawings and general provisions of the Contract, including main Contract Preliminaries and section A of this specification.
- B For performance details and physical sizes of cables trays and equipment refer to drawings and this specification. For cable details refer to section D "Schedules of Equipment".
- C For system application selections schedules, operating parameters and ambient temperatures refer to section B of this specification.
- D Refer also to the following sections:
 - 1 Low Voltage Distribution: V30
 - 2 Electrical Identification: V80
 - 3 Earthing and Bonding Systems: V81
 - 4 Electrical Inspection and Testing: Y50
 - 5 Conduit and Trunking: Y60
 - 6 LV and ELV Cables: Y61
 - 7 Electrical Accessories: Y65
 - 8 Fixing to Building Fabric: Y90.

Y63.1.2 SUMMARY

- A This Section includes the following with associated accessories for above ground services distribution installations:
 - 1 Perforated cable trays
 - 2 Cable racks/ladders
 - 3 Cable baskets
 - 4 Cable Cleats
 - 5 Cable Ties.
- B For below ground draw pits, chambers and underground ducts and trenching details refer to section P30.
- C For trunking and conduit see section Y60.

Y63.1.3 DEFINITIONS

- A **Perforated Cable tray:** A perforated metal tray with integrated side members used to support insulated cables for power distribution and communication.
- B **Cable Ladder/rack:** An open metal rung type system with substantial side members offering increased loading capacity for supporting larger power distribution cables
- C **Cable basket:** Wire mesh type tray with sides turned up to form a basket. Generally used for smaller cables
- D **Cable trunking:** A lidded assembly comprising a trunking length and possibly other system components to provide an enclosure for the accommodation and laying in of insulated conductors and cables and possibly the accommodation of other electrical equipment.
- E **Cable cleat:** Device designed to provide securing of cables when installed at intervals along the length of cables. A cable cleat is provided with a means of attachment to a mounting surface but does not rely on an unspecified mounting surface for the retention of the cables. Examples of mounting surfaces that may be specified are ladder, tray, strut, or rail, wire and beam. Where declared, cable cleats provide resistances to electromechanical forces.
- F **Intermediate restraint:** Cable retaining device to be used with cable cleats to hold the cables together in order to provide resistance to electromechanical forces. Intermediate restraints are not attached to the mounting surface'.

G The following acronyms are used in this specification and on the drawings:

- 1 LSF: Low Smoke and Fume
- 2 LV: Low voltage
- 3 V0: Classification of the ignition and burning resistance
- 4 EPDM: Ethylene-propylene-dieneterpolymer rubber
- 5 Comms: Communications systems
- 6 PAVA: Public Address and Voice Alarm System
- 7 BMS: Building Management System
- 8 NBR: Acrylonitrile-butadiene rubber.
- 9 RNC: Rigid non-metallic conduit.
- 10 SWL: Safe Working Load
- 11 PVC: Polyvinyl chloride.

Y63.1.4 PERFORMANCE REQUIREMENTS

- A To provide a system for the support of a combination of cables, electrical equipment and/or communication system installations as indicated on the drawings. Where necessary cable tray systems may be used for the segregation of cables.
- B Systems are to be designed for use as supports for cables and not as enclosures giving full mechanical protection.
- C Applications: Use as indicated on the drawings, as indicated in section B of this specification or where not shown comply with the following general applications:
- 1 **Perforated Cable tray:** Use for applications where some physical strength is required typically where system is exposed to view including Data, LV sub mains cabling, fire alarm, shorter spans and medium loads and medium heat producing cables
 - 2 **Cable Ladder rack:** Use for Main LV & HV cabling and sub mains distribution, greatest heat generating cables and for longer spans and heaviest loads
 - 3 **Cable basket:** Use for Fire Alarm, PAVA, BMS, Data, Voice, Lighting control and Comms installations in false ceilings and raised floor where greater ventilation is required. Spans are shorter and lighter loading. Physical protection is limited
 - 4 **Cable trunking:** Use for final LV circuits, single cables, Data, Comms, security, fire alarm and BMS cables. Spans short and lighter loading. Refer to section Y60
 - 5 **Cable cleat:** Install at recommended spacing along lengths of cables in order to provide resistance to electromechanical force. Cleats are attached to the mounting surface
 - 6 **Intermediate restraint:** installed together with cable cleats to hold the cables together in order to provide resistance to electromechanical forces. Intermediate restraints are not attached to the mounting surface.
- D Life Safety and Firefighting Power supplies: Comply with the requirements and recommendations of:
- 1 BSRIA BG 70/2017: Life Safety and Firefighting power supplies
 - 2 BS EN 1366 Series of standards: Fire resistance tests for service installations
 - 3 BS 8519: Selection and installation of fire-resistant power and control cable systems for life safety and fire-fighting applications. Code of practice. Note the following:
 - a Primary and secondary sources of supply should be diversely routed and adequately separated to ensure that a failure of either cable/containment system does not affect the alternative supply
 - b Protect against fire and water damage for the minimum period of the specified fire survival time for the applications of table 1 BS 8519
 - c Life safety and firefighting cabling should be segregated from non-life safety cables. Provide dedicated Life Safety and firefighting cable containment designed to maintain its integrity under fire conditions for the specified fire survival time.
- E Give consideration to the following factors when undertaking the design of a support system although some of these (e.g. snow/wind loads) may not be relevant to every installation:

- 1 Distributed loads (eg. cables, pipes)
- 2 Point loads
- 3 Segregation of cables (firefighting, life safety, IT, security etc)
- 4 Snow, wind and external forces
- 5 Safety factor
- 6 Deflection
- 7 Spacing of supports
- 8 Location of couplers
- 9 Testing of cables within a support system
- 10 Electrical continuity
- 11 Earth protection
- 12 Electromagnetic compatibility (EMC)
- 13 Thermal expansion or building movement joints.

F Provide full and detailed calculations for the loading of all cable trays, ladders and support systems. Calculations to be reviewed by structural engineer. Comply with the following:

- 1 Distributed loads: Allow both the physical space and sufficient load carrying capacity for the future addition of 25% more cables or other loading medium
- 2 Point loads: Provide adequate support for point loads. Point loads may consist of permanent equipment, such as lighting luminaires, junction boxes or other switchgear, or temporary loads such as commissioning equipment or installation personnel
- 3 Snow, wind and external forces: If the system is outdoors and must also sustain snow, ice, wind or other variable forces these must also be taken into account at the design stage:
 - a Appropriate design data for UK weather conditions is given in BS EN 1991.
- 4 Safety factor: Select appropriately but never less than 1.7. Increase if installation could be subject to abuse or other external influences.
- 5 Deflection:
 - a Along the length: Never more than 1/200th of the span between supports at SWL
 - b Across the width: Never more than 1/20th of the width.
- 6 For life safety and firefighting cables the Integrity of the support system under fire conditions; refer to BSRIA BG 70/2017

G For tray and ladder systems consideration must be given to a number of other factors:

- 1 Where cables cross each other such as in a tee or four way / cross, extra space will be required
- 2 Depending upon the type of installation, future wiring needs could well require spare trunking capacity
- 3 Larger cables, in particular, do not lie neatly and flatly. Consideration must be given to the practicality of laying cable
- 4 A 50% reduction in capacity will apply at tees and four way / crosses unless offset fittings are used.

Y63.1.5 SUBMITTALS

A Product Data: For cable trays ladder racks, cable baskets and fittings, include data indicating dimensions and finishes for each type of cable tray and cable ladder. Provide details of corrosion resistance and manufacturer's recommended selection for each type of environment into which the systems are to be installed.

B Support Calculations:

- 1 Where cable ladder and cable tray support systems are fixed to primary supports (e.g. Structural steel work or elements of the building) it is important to ensure that the primary supports are strong enough to carry the imposed loads. Submit details of all loads at the points of support and obtain approval from the structural engineer for the suitability of the support system and method of attachment to the structure
- 2 Provide cable cleat sizing data to demonstrate that type and spacing can resist the forces that could potentially be applied to the systems

- 3 Provide loading calculations that demonstrate the suitability of the ladder/tray system to support the designed and future spare capacity loadings. Provide details of maximum deflection and safety factors applied.
 - 4 For life safety and firefighting cables demonstrate that containment support is designed to take protect against the effects of fire and water damage.
- C Shop Drawings: For each type of cable tray, ladder/rack or basket:
- 1 Show fabrication and installation details of cable tray, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
- D Samples for Initial selection: For cable trays, cable baskets and trunking with factory-applied finish and colour that are intended to be used in the installation. Samples to include proposed finishes for each of the particular environment s into which the trays/ladder racks are to be installed. All samples to be minimum of 300mm long:
- 1 Perforated tray:
 - a Light duty: 12mm deep x 150mm wide
 - b Light duty: 18mm deep x 300mm wide
 - c Medium duty: 25mm deep x 450mm wide
 - d Heavy duty: 50mm deep x750mm wide
 - 2 Ladder Rack:
 - a Light duty: 50mm deep x 300mm wide
 - b Medium duty: 100mm deep x 450mm wide
 - c Heavy duty: 125mm deep x 600mm wide
 - d Extra Heavy Duty: 150mm deep x 750mm wide
 - 3 Cable Basket:
 - a Light duty: 35mm deep x 150mm wide
 - b Medium duty: 60mm deep x300 mm wide
 - c Heavy duty: 100mm deep x 600mm wide
- E Coordination Drawings: cable tray/basket/ladder routing plans, drawn to scale, on which the following items are shown and coordinated with other services installations, based on input from installers of the items involved:
- 1 Cable tray Vertical and horizontal offsets and transitions
 - 2 Clearances for access above and to side of cable trays
 - 3 Vertical elevation of cable trays above the floor or bottom of ceiling structure.
- F Qualification Data: For professional engineer providing calculations.
- G Source quality-control test reports.

Y63.1.6 QUALITY ASSURANCE

- A Source Limitations: Obtain cable tray components through one source from a single manufacturer.
- B Electrical Components, Devices, and Accessories: Listed and labelled as defined in BS 7671, by a testing agency acceptable to authorities having local jurisdiction and marked for intended use.
- C Comply with the following standards:
- 1 BS 476-20: Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles)
 - 2 BS 1710 - Specification for identification of pipelines and services
 - 3 BS 5733 - General Requirements for Electrical Accessories
 - 4 BS 6701: Telecommunications equipment and telecommunications cabling. Specification for installation, operation and maintenance.
 - 5 BS 6946: Specification for metal channel cable support systems for electrical installations.
 - 6 BS 7371-1: Coatings on metal fasteners. Specification for general requirements and selection guidelines

- 7 BS 7671: Requirements for electrical installations. IET Wiring Regulations.
- 8 BS 8519: Selection and installation of fire-resistant power and control cable systems for life safety and fire-fighting applications. Code of practice
- 9 BS EN 1366 Series of standards: Fire resistance tests for service installations
- 10 BS EN 1366-3: Fire resistance tests for service installations. Penetration seals
- 11 BS EN 1366-5: Fire resistance tests for service installations. Service ducts and shafts
- 12 BS EN 1991-1-3: Eurocode 1. Actions on structures. General actions. Snow loads
- 13 BS EN 1991-1-4: Eurocode 1. Actions on structures. General actions. Wind actions
- 14 BS EN 10025-2: Hot rolled products of structural steels. Technical delivery conditions for non-alloy structural steels
- 15 BS EN 10088-1: Stainless steels. List of stainless steels
- 16 BS EN 10088-2: Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes
- 17 BS EN 10088-3: Stainless steels. Technical delivery conditions for bars, rods, wire, sections and bright products of corrosion resisting steels for construction purposes
- 18 BS EN 10143: Continuously hot-dip coated steel sheet and strip. Tolerances on dimensions and shape
- 19 BS EN 10162 - Cold rolled steel sections. Technical delivery conditions. Dimensional and cross-sectional tolerances
- 20 BS EN 10210 - Hot finished structural hollow sections of non-alloy and fine grain structural steels
- 21 BS EN 10244-2: Steel wire and wire products. Non-ferrous metallic coatings on steel wire. Zinc or zinc alloy coatings
- 22 BS EN 10346: Continuously hot-dip coated steel flat products. Technical delivery conditions
- 23 BS EN 50085-1: Cable trunking systems and cable ducting systems for electrical installations. General requirements
- 24 BS EN 50174-2: Information technology. Cabling installation. Installation planning and practices inside buildings
- 25 BS EN 50174-1 Information technology. Cabling installation. Installation specification and quality assurance
- 26 BS EN 60529 - Specification for degrees of protection provided by enclosures (IP code)
- 27 BS EN 60670-22 - Boxes and enclosures for electrical accessories for household and similar fixed electrical installations. Particular requirements for connecting boxes and enclosures.
- 28 BS EN 61386-21: +A11: Conduit systems for cable management. Particular requirements. Rigid conduit systems
- 29 BS EN 61386-23+A11: Conduit systems for cable management. Particular requirements. Flexible conduit systems
- 30 BS EN 61537: Cable management. Cable tray systems and cable ladder systems
- 31 BS EN 61914: Cable cleats for electrical installations
- 32 BS EN ISO 1461: Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods
- 33 BS EN ISO 2081: Metallic and other inorganic coatings. Electroplated coatings of zinc with supplementary treatments on iron or steel
- 34 BS EN ISO 12683: Mechanically deposited coatings of zinc. Specification and test methods
- 35 BS EN ISO 12944-2: Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Classification of environments
- 36 BS EN ISO 14713-1: Zinc coatings. Guidelines and recommendations for the protection against corrosion of iron and steel in structures. General principles of design and corrosion resistance
- 37 BS EN ISO 17668: Zinc diffusion coatings on ferrous products. Sherardizing. Specification
- 38 PD 6484: 'Commentary on corrosion at bimetallic contacts and its alleviation.'

Y63.1.7 DELIVERY, STORAGE, AND HANDLING

- A Store all cable tray, cable ladder/rack and cable basket indoors in a dry and well-ventilated location to prevent water or other foreign materials from staining or adhering to cable tray. Unpack and dry wet materials before storage.
- B Protect cable tray from scratching and marring of finish.

Y63.2 PART 2 – PRODUCTS

Y63.2.1 MANUFACTURERS

- A Cable Tray, Cable Ladder Rack and Cable Basket Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1 Legrand
 - 2 Metsec
 - 3 Vantrunk
 - 4 Unistrut
 - 5 Schneider
 - 6 Unitrunk
 - 7 Cablofil
 - 8 Ellis
 - 9 Marco
 - 10 An alternative manufacturer's equipment may be submitted for approval.

Y63.2.2 CABLE SUPPORT SYSTEMS GENERAL

- A Cable support systems are to be suitable for the environment into which they are to be installed. Use the most appropriate materials /finishes for the environment and degree of pollution into which they are to be located:
- 1 Manufacturing Standard: BS EN 61537
 - 2 Design to allow for any additional forces that could be applied to the support systems such as wind, snow in addition to the weight of the cables
 - 3 Support systems: Design supports to suit the imposed loads and the nature and spacing of the supporting structure to which the supports are attached.
- B Provide resistance to corrosion by selecting suitable materials and finishes as indicated below for various environments. Use these or project specific requirements if indicated on the drawings or within specification section B. When using stainless steel, check the suitability of the particular type (304L or 316L) for the nature of the airborne pollution:
- 1 **Internal, normal heated environment:** Corrosion Class C1- very low (BS EN ISO 12944-2)
 - a Mild steel Electro galvanising after manufacture: BS EN ISO 2081
 - 2 **Internal, non- heated areas with low levels of humidity and pollution:** Corrosion Class C2- Low (BS EN ISO 12944-2)
 - a Mild steel Pre-Galvanised: BS EN 10244-2
 - 3 **External installation in urban environment/ some Industrial pollution:** Corrosion Class C3/C4- average to high (BS EN ISO 12944-2)
 - a Mild steel Hot dip galvanised after manufacture: BS ISO 1461
 - 4 **Chemical industries, nitrate explosives, photography, high levels of humidity:** Corrosion Class C5-I- very high industrial (BS EN ISO 12944-2)
 - a Stainless steel; type 316L: BS EN 10088 Grade 1-4404
 - 5 **Marine, harsh or sulphurous environments, very high humidity:** Corrosion Class C5-M Very high marine (BS EN ISO 12944-2)
 - a Stainless steel: Type 316L: BS EN 10088 Grade 1-4404
 - 6 **Acid or alkaline environments, high humidity:** Corrosion Class C5-I- very high industrial (BS EN ISO 12944-2)
 - a Stainless steel: Type 304L: BS EN 10088 Grade 1-4301
 - 7 **Food production:**
 - a Stainless steel: Type 304L: BS EN 10088 Grade 1-4301
 - 8 **Aesthetic appearance:** Colour powder coating: Use only where indicated. Powder coating to be of approved colour over hot dip galvanised finish.

Y63.2.3 PERFORATED TRAY

- A Proprietary system of perforated metal tray and compatible jointing and fixing accessories formed into a U section of various widths and heights. Select tray to suit cable loading requirements and check with manufacturer detailed loading calculations for all proposed installations.
- B Typical maximum loading (SWL) for maximum spans as indicated: (safety factor 1.7). Maximum deflection 1/200th of span. Check details with specific manufacturer:
- | | |
|---|-----------------------|
| 1 Light duty (12mm deep and 50-225mm wide): | 10 kg/m per 1m span |
| 2 Light duty (18mm deep and 300mm wide): | 20 kg/m per 1.5m span |
| 3 Medium duty (25mm deep and ≥300mm wide): | 60 kg/m per 1.5m span |
| 4 Heavy duty (50mm deep): | |
| a 75-150mm wide: | 50 kg/m per 2m span |
| b 225-300mm wide: | 80 kg/m per 2m span |
| c 450-600mm wide: | 150 kg/m per 2m span |
- C Select cable tray material and finish to be suitable for the environment into which it is to be installed. See general clause above.
- D Construction: use mild steel with appropriate finish or stainless steel if required to suit the environment.
- 1 Standards: Materials and quality
 - a Manufacturing Standard: BS EN 61537
 - b Mild Steel: BS EN 10025-2
 - c Stainless steel: BS EN 10088.
 - 2 Types:
 - a Light duty: non- return flanged
 - b Medium duty: return edge flanged to provide a rounded surface for ease of cable management and greater strength
 - c Heavy duty: return flanged to provide a rounded surface for ease of cable management.
 - 3 Fittings: Use factory made fittings throughout of same material, type, pattern, finish and thickness as cable tray:
 - a Use reducers, inside angles and outside angles as manufacturer's standard
 - b Use flat bends, equal tees, unequal tees and crosses with corners gusseted
 - c Join lengths of tray and fittings using manufacturer's standard shouldered ends, fish plates, or couplers, with galvanized or zinc plated slotted domed head 'roofing' bolts, nuts, washers and shake-proof washers.
 - 4 Perforation: Manufacturer's standard 15-30%
 - 5 Dimensions: Standard widths:
 - a Light duty (12mm deep):
 - 0.9mm gauge: 50,75,100,150mm
 - 1.2mm gauge: 225mm.
 - b Light duty (18mm deep): 300mm/1.2mm gauge
 - c Medium duty (25mm deep):
 - 0.9mm gauge: 50,75,100,150,225mm,
 - 1.5mm gauge: 300,450,600mm.
 - d Heavy duty (50mm deep):
 - 0.9mm gauge: 75,100,150mm
 - 1.2mm gauge: 225,300mm
 - 1.5mm gauge: 450,600mm
 - 2.0mm gauge: 750,900mm.

Y63.2.4 CABLE RACK/CABLE LADDER

- A Proprietary system of channel sections with rung type cross members at 300mm maximum intervals complete with compatible jointing and fixing accessories. Select ladder to suit cable loading requirements and check with manufacturer detailed loading calculations for all proposed installations.

- B Typical maximum loading (SWL) for 3m span: (safety factor 1.7). Maximum deflection 1/200th of span. Check details with specific manufacturer:
- | | | |
|---|--------------------------------|-----------|
| 1 | Light duty (50mm deep): | 50 kg/m |
| 2 | Medium duty (100mm deep): | 140 kg/m |
| 3 | Heavy duty (125mm deep): | 225 kg/m |
| 4 | Extra Heavy Duty (150mm deep): | 300 kg/m. |
- C Select cable ladder material and finish to be suitable for the environment into which it is to be installed. See general clause above.
- D Construction: use mild steel with appropriate finish to suit the environment or stainless steel if required to suit the environment:
- | | |
|---|-------------------------------------|
| 1 | Manufacturing Standard: BS EN 61537 |
| 2 | Mild Steel: BS EN 10025-2 |
| 3 | Stainless steel: BS EN 10088. |
- E Dimensions:
- | | |
|---|---|
| 1 | Standard widths: 150,300,450,600,750,900mm |
| 2 | Standard profiles: Height x width |
| | a Light duty: 50x20mm side rails, 1.5mm thick |
| | b Medium duty: 100x20mm side rails, 1.5mm thick |
| | c Heavy duty: 125x20mm side rails, 2.0mm thick. |
| | d Extra heavy duty: 150x20mm side rails, 2.0mm thick. |
| 3 | Standard length: 3000mm, 6000mm. |
- F Fittings:
- | | |
|---|---|
| 1 | Use factory made fittings throughout of same material finish and section as ladder rack, for risers, bends, reducers, tees, crosses and dropouts. |
|---|---|

Y63.2.5 CABLE BASKET

- A Proprietary system of wire basket with compatible jointing and fixing accessories. Wire mesh cable tray sections shall be manufactured from multiple round steel wires, welded into a square/rectangular mesh and formed into straight sections of U-shaped tray in various heights and widths.
- B Description: 50x50mm (maximum) steel wire grid cable tray basket. Standard lengths 3000mm. Standard depths and widths as follows:
- | | | |
|---|-----------------|--|
| 1 | 30-35 mm deep: | 60, 100, 150, 200, 300, mm wide |
| 2 | 54-60mm deep: | 60,100,150, 200, 300, 400, 450, 500, 600 mm wide |
| 3 | 100-105mm deep: | 150, 200, 300, 400, 500, 600 mm wide. |
- C Manufacturing Standard: BS EN 61537. Wire minimum dimensions:
- | | | |
|---|-------------------|--------------|
| a | Widths 50-200mm: | 4mm diameter |
| b | Widths 300-600mm: | 5mm diameter |
- D Typical maximum loading (SWL) for 1.5m span: (safety factor 1.7). Maximum deflection 1/200th of span. Check details with specific manufacturer:
- | | | |
|---|--------------------------|-----------|
| 1 | Light duty (35mm deep): | |
| | a 100mm wide: | 7.9 kg/m |
| | b 150mm wide: | 8.8 kg/m |
| | c 200mm wide: | 9.1 kg/m |
| 2 | Medium duty (60mm deep): | |
| | a 100mm wide | 16.2 kg/m |
| | b 150mm wide | 17.0 kg/m |
| | c 200mm wide | 17.0 kg/m |
| | d 300mm wide | 21.2 kg/m |

- | | | |
|---|------------|-----------|
| e | 400mm wide | 24.6 kg/m |
| f | 500mm wide | 25.0 kg/m |
| g | 600mm wide | 26.5 kg/m |
- 3 Heavy duty (100mm deep):
- | | | |
|---|------------|------------|
| a | 200mm wide | 29.7 kg/m |
| b | 300mm wide | 30.6 kg/m |
| c | 400mm wide | 31.2 kg/m |
| d | 500mm wide | 32.3 kg/m |
| e | 600mm wide | 35.0 kg/m. |
- E Basket finish to be suitable for the environment into which they are to be installed. Suitable materials and finishes are indicated above for various environments. Use these or project specific requirements if indicated on the drawings or within specification section B.
- F Fittings:
- 1 Use factory made fittings throughout of same material finish as basket, for risers, bends, reducers, tees, crosses and dropouts.

Y63.2.6 CABLE CLEATS

- A Application: to restrain cables such that they can withstand the forces which are generated in operation and during a short circuit. Cleats to be designed and selected so that they are:
- 1 Capable of accommodating a pre-defined size or range of cable or cable bundle diameter without cracking or breaking, or stripping screw threads
 - 2 Resistant to impact at the minimum declared temperature
 - 3 Capable of withstanding the lateral load at the maximum declared temperature
 - 4 Capable of withstanding the axial load at the maximum declared temperature
 - 5 Resistant to electromechanical forces
 - 6 Non-metallic and composite cable cleats to have adequate resistance to flame propagation. Metallic or composite cleats shall have adequate resistance to corrosion
 - 7 The surfaces of cleats and intermediate restraints to be free from sharp edges, burrs, flash, etc. that are likely to damage cables or inflict injury to the installer or user.
- B Standards: installation and testing in accordance with:
- 1 BS EN 61914: Cable cleats for electrical installations.
- C Cable cleats installed to cable containment (whether cable tray, ladder or basket) are to be provided at the correct spacing to contain potential short-circuit forces generated by the low/high voltage power cable system. Seek advice from the manufacturer and select cleats and spacing in consideration of the following after calculating the electromechanical forces and the maximum available fault duty of the system:
- 1 Installation environment
 - 2 Mounting structure
 - 3 Cable configuration
 - 4 Peak short circuit fault level
 - 5 Cable diameter.
- D Construction:
- 1 Use LSF pads for Cable Cleats and intermediate restraints where the cable would otherwise be in direct contact with a metal component to:
 - a Cushion cables from the magnetic forces arising during fault currents, and
 - b Protect cables from chafing against the mounting system between two modules subject to the differential movement (common on offshore structures and marine vessels), and
 - c Protect the cables from the extreme movement found in high-shock installations (e.g. military and seismic applications)
 - d Restrain cables from axial movement in vertical cable runs or during periods of thermal elongation
 - 2 Each Cable Cleat to have the capability to accommodate a range of cable outside diameters

- 3 Metallic or composite cleats shall be non-magnetic 316L marine grade stainless steel (including brackets, mounting adapters and any permanently mounted manufacturer supplied installation and fastening means)
 - 4 Pads shall be low-smoke, low-fume, zero halogen, polymeric material with UV stabilization for use in high salt, marine outdoor (e.g. exposed to sunlight) locations
 - 5 Cable Cleats shall have "edge folded" design to protect cable outer sheathing in the event of a short circuit
 - 6 Cable Cleat edges shall be free of burrs and cracks to ensure cable safety.
 - 7 The manufacturer to provide test reports and product data sheets detailing the peak and RMS currents to which the cable cleats have been tested.
- E Single cable cleat configurations: Use for single cables laid in a parallel/flat plane usually with equal spacing between adjacent cables:
- 1 One bolt LSF (V0) nylon suitable for:
 - a Lateral load test: 1kN -1.25kN
 - b Axial Load test: 0.5kN - 1kN
 - c Material: V0 nylon black colour
 - d Impact resistance classification: Very Heavy
 - e Sizes: 10mm to 57mm
 - 2 One bolt Aluminium suitable for:
 - a Lateral load test: 5kN -6kN
 - b Axial Load test: 1.5kN
 - c Material: High pressure die cast aluminium, silver/grey
 - d Impact resistance classification: Very Heavy
 - e Sizes: 10mm to 71mm
 - 3 One bolt Heavy duty Stainless steel hinged clamp type suitable for:
 - a Lateral load test: 3.5kN-14.5kN
 - b Axial Load test: 0.2-0.9kN
 - c Impact resistance classification: Very Heavy
 - d Sizes: 32mm to 150mm
 - 4 Two bolt die cast aluminium suitable for:
 - a Lateral load test: 18kN-32kN
 - b Axial Load test: 8kN
 - c Impact resistance classification: Very Heavy
 - d Sizes: 38mm to 151mm.
- F Trefoil cable cleat formation: Use for the formation of three cables so laid to be mutually equidistant. Viewed in cross-section, the lines joining the cable centres form an equilateral triangle:
- 1 Single bolt light duty, hinged clamp type aluminium with LSF liner suitable for
 - a Lateral load test: Manufacturer to advise
 - b Axial Load test: Manufacturer to advise
 - c Impact resistance classification: Very Heavy
 - d Sizes: 19mm to 128mm
 - 2 Single bolt standard duty, hinged clamp type, stainless steel with LSF liner suitable for
 - a Lateral load test: Manufacturer to advise
 - b Axial Load test: Manufacturer to advise
 - c Impact resistance classification: Very Heavy
 - d Sizes: 19mm to 128mm.

Y63.2.7 TRAY AND LADDER RACK SUPPORT SYSTEMS

- A Support trays, baskets and ladder rack systems from the building structure in conformance with BEAMA "Best Practice Guide to Cable Ladder and Cable Tray Systems Including Channel Support Systems and other Associated Supports".
- B Design supports and submit calculations in accordance with this specification. Supports shall:

- 1 Support the weight of the trays/ladder, cables, and equipment connected to it including allowances for spare capacity and other external loads that may be applied
 - 2 Control the movement of the trays
 - 3 Direct and transfer the static and dynamic loadings into the supporting structure.
- C Ensure that materials used are compatible with the tray/ladder materials.
- D Do not use cantilever type supports because the wall itself may not have been designed to cater for this type of loading.
- E Support system to be constructed of corrosion resistant materials suitable for the environment into which they are to be used. Generally, use the same material or better as required for the tray/ladder rack system itself.
- F Support systems may comprise:
- 1 Trapeze type supports
 - 2 Proprietary threaded rod suspension brackets
 - 3 Bolted metal framing channels.
- G Standards:
- 1 BS 6946 Specification for metal channel cable support systems for electrical installations
 - 2 BS 7671: Requirements for electrical installations. IET Wiring Regulations
 - 3 BS EN 50174-1: Information technology. Cabling installation. Installation specification and quality assurance
 - 4 BS EN 50174-2: Information technology. Cabling installation. Installation planning and practices inside buildings
 - 5 BS 6701: Telecommunications equipment and telecommunications cabling. Specification for installation, operation and maintenance.
 - 6 BS 8519: Selection and installation of fire-resistant power and control cable systems for life safety and fire-fighting applications. Code of practice
 - 7 BS EN 1366 Series of standards: Fire resistance tests for service installations

Y63.2.8 TRAPEZE HANGERS

- A Description: Shop or field-fabricated tray/ladder support assembly made from steel angles or channels with two steel hanger rods and nuts either side. Hangers supported by threaded drop rods in pairs from channel support systems or other primary structural elements.
- B Use mild steel with appropriate finish or stainless steel to suit the environment and the material used for the tray/ladder construction.
- C SWL: Consult with manufacturer/designer for specific details.

Y63.2.9 PROPRIETARY THREADED ROD SUSPENSION BRACKETS

- A Manufacturer's proprietary suspension brackets may be used for the installation of cable basket systems or slotted channel supports. Typically used for restricted space where trapeze hangers cannot be used.
- B Drop rod brackets are fixed in pairs to opposite outsides of the rails to form two supports at each location. Use manufacturer's brackets and bolt systems using four nuts and washers to fix each bracket to the drop rod.
- C SWL: Consult with manufacturer for specific details.

Y63.2.10 METAL FRAMING SYSTEMS

- A Manufacturers: Subject to compliance with requirements, provide proprietary products by an approved manufacturer of the cable tray/ladder system.

- B Description: Shop or field-fabricated tray/ladder support assembly for supporting multiple cable trays/ladders. Use mild steel with appropriate finish or stainless steel to suit the environment and the material used for the tray/ladder construction.
- C Construction:
- 1 Channels: Continuous slotted steel channel within turned lips
 - 2 Channel nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel
 - 3 Hanger rods: For overhead support use continuous-thread rod, nuts, and washer made of carbon steel with metallic coating or stainless steel
 - 4 For vertical installation: use channel section fixed to wall
 - 5 Metallic coating: Electroplated zinc or hot-dipped galvanized.
- D Dimensions: Typical manufacturers standard uses 1.5mm or 2.5mm thick steel of the following profile.
- 1 41 x 41mm
 - 2 41 x 21mm.
- E SWL: Consult with manufacturer for specific details.

Y63.2.11 CABLE FASTENINGS

- A Cable Ties: Used to bundle up and fix cables to trays/ladder racks. Use type appropriate for the application:
- 1 Indoor: Clear polyamide (PA66) halogen free
 - 2 Outdoor: UV stabilised black polyamide (PA66) halogen free
 - 3 Do not use in acidic or environments containing phenols.
- B Cable Tie types:
- 1 Two piece: For use on cable tray only by inserting strip into tray slots and twisting through 90°
 - 2 Wrap round self-locking non-releasable pattern on everything except cable trays.

Y63.2.12 WARNING SIGNS

- A Provide warning signs as follows:
- 1 Lettering: 40-mm high, black letters on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."
 - 2 Materials and fastening are specified in V80 Electrical Identification.

Y63.3 PART 3 – EXECUTION

Y63.3.1 PREPARATION

- A Prior to installing cable on the tray or ladder, examine the cable paths to ensure all areas are free of debris that may interfere with the cable's installation. Surface areas of tray or ladder components likely to come into contact with cables shall not cause damage to the cables when installed according to the manufacture's instruction or this specification.
- B Ensure that all the materials used to support the cables are suitable for the environment into which they are to be installed.
- C Install the cable tray system according to the coordination drawings and the tray manufacturer's assembly and installation instructions.
- D Life Safety and firefighting cables: Check that:
 - 1 Proposed primary and secondary supply routes are adequately separated and diverse.
 - 2 Cables are routed on dedicated containment systems

Y63.3.2 TRAY BASKET AND LADDER RACK INSTALLATION GENERAL

- A Comply with the requirements of BS 7671.
- B Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended by the manufactures Space connectors and set gaps according to applicable standard.
- C Make changes in direction and elevation using standard fittings.
- D Make cable tray connections using standard fittings.
- E Seal penetrations through fire and smoke barriers.
- F Sleeves for future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- G Workspace: Install cable trays with enough space to permit access for installing cables.
- H Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels.
- I After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

Y63.3.3 CABLE BASKET/TRAY INSTALLATION

- A Assemble basket/ trays into a continuous pathway using the tray manufacturer's splices and recommended assembly practices:
 - 1 Spring splices are acceptable for trays that are less than 450 mm wide.
 - 2 Mechanical/bolted splices are required for all trays wider than 400 mm.
 - 3 Ends of coupling bolts shall not come into contact with the cables.
 - 4 No welding to be used in the joining of cable trays.
- B Bonding and Earthing:
 - 1 Bond individual tray sections together using a common bonding conductor if necessary, for continuity
 - 2 Attach the bonding conductor directly to each tray using a split bolt earthing lug according to the tray manufacturer's installation instructions
 - 3 Verify bond across each splice
 - 4 Bond tray pathway to the appropriate earthing building busbar.
- C Supports:

- 1 Support trays from the wall, ceiling or floor using the tray manufacturer's supports and recommended installation practices
 - 2 Provide appropriate installation hardware for each support based on site requirements
 - 3 Secure the tray to the support before loading the tray with cables
 - 4 Fix at regular intervals in accordance with Manufacturer's recommendations but not exceeding 1500mm and at 225mm from bends and intersections
 - 5 Provide a minimum clear space of 25mm behind all cable trays.
- D Accessories:
- 1 Provide a radius drop to support cables at any point where cables enter or exit the pathway
 - 2 Separate and cover pathways as required in the project drawings
 - 3 Bends, tees, risers, reducers and four-way crosspieces shall be factory made wherever possible, and shall be of the same construction, material, thickness and finish as the cable tray
 - 4 All tees and crosspieces shall have a 45°gusset on each side from the point of intersection.
- E Cutting:
- 1 Cut cable trays only along a line of unperforated material
 - 2 Fit grommets, bushes or other lining for all holes cut in cable trays for the passage of cables
 - 3 Cutting of cable trays to be kept to a minimum.
- F Cable installation:
- 1 Cables to be laid on the cable tray and secured by ties, each tie securing the cables of only one circuit.
 - 2 The ties shall be of a proprietary type low in halogen, self-extinguishing and ultra-violet resistant
 - 3 The use of wire or similar material is not permitted
 - 4 Ties shall be used at less than 600mm intervals along each cable, and within 100mm of each bend or set
 - 5 Use cable cleats supports where cable trays are vertical
 - 6 Mineral-insulated cables on vertical trays to be supported by saddles or clips
 - 7 Provide a 20mm gap at building or structural expansion joints and provide cable tray supports within 150mm of either side of the joint
 - 8 Seal penetrations through fire and acoustic barriers so that fire/acoustic rating of the intervening structure is not compromised.
 - 9 Use metallic cable ties, straps and cleats for securing all cables on escape routes in accordance with BS 7671 + A3.

Y63.3.4 CABLE LADDER/RACK INSTALLATION

- A Cable ladder installations are usually designed with a significantly longer spacing between supports, 2 to 4 metres being a typical span distance.
- B Supports:
- 1 Ensure that couplers are not located at mid span position. Locate couplers at quarter of the span distance on either side of each point of support
 - 2 Cable ladder fittings must always be provided with local support in accordance with the manufacturer's instructions
 - 3 End spans to have additional supports to ensure SWL is not exceeded
 - 4 Use a maximum of 600mm cable tray externally due to adverse effects from snow and wind.
- C Cable Protection:
- 1 Cable ladder is deemed to provide continuous support to any cables installed upon it but, because it is not completely enclosed, it does not offer mechanical protection. For this reason, unsheathed, single insulated power cables should not be installed on ladder
 - 2 All cables should have some mechanical protection in the form of PVC sheathing, steel wire armouring or a copper covering (MICC)
 - 3 Where moisture may be present, copper covered cables must also be PVC sheathed to avoid electrochemical corrosion between the copper and the cable support system.
- D Earth Protection:

- 1 Cable ladder can be specifically designed to act as a circuit protective conductor (CPC), which connects exposed conductive parts of equipment to the main earth terminal and will thereby provide some protection against electric shock. For this to be acceptable the cross-sectional area of the cable support must exceed a value obtained by calculation, the formula for this calculation being given in Regulation 543-01-03 of the Wiring Regulations BS 7671. This formula takes into account the fault current of the circuit, the nature of the cables themselves and the operating time of the disconnecting device used to protect against excessive currents
- 2 Other features, such as protection of the support system against mechanical damage and corrosion (to ensure the CPC remains intact), visual identification that the support system is being used as a CPC and the impedance of the circuit must also be considered before ladder can be used as a CPC.
- 3 If armoured cables (with an integral CPC) are installed on a ladder and the support system is not being used as a protective conductor, then it is generally considered as a metal part which is neither extraneous nor exposed; continuity is not an issue in this situation. Normal ladder assembly methods are adequate and BS 7671 (the Wiring Regulations) impose no requirement for continuity of such metal parts unless they are being used as a protective conductor
- 4 If unarmoured cables are installed on a ladder installation which is not being used as a protective conductor, consideration should be given to the possibility of damage to these cables, causing the ladder to become live and hence the need to earth the support system
- 5 The continuity of properly fixed ladder joints is such that earth continuity connectors (bonding connectors) are not necessary for any general ladder application; however, in special locations or hazardous areas (as described in BS 7671: Section 6) earth continuity connectors may be required.

E Electromagnetic Compatibility (EMC):

- 1 In normal use cable ladder is considered as passive in respect of electromagnetic influences. The installation of current carrying media may cause emissions and these media may also be influenced by electromagnetic signals from elsewhere, but the degree of influence will depend on the nature of the installation and the apparatus connected to the system
- 2 Draft technical report IEC1000-S-1 provides details of the cable separation required according to the type of signal being considered and the IEE Guidance Note No.1 provides further information on the subject of EMC. However, as a basic principle, if power and signal cables can be run separately on different ladders then this will significantly reduce any possibility of one electrical circuit having any undesirable influence upon another.

F Thermal expansion and contraction:

- 1 In locations where large variations in temperature are anticipated the design of the support system should make allowance for changes in the length of the support system due to the expansion and the contraction of the metal
- 2 For cable ladder, flexible couplers provide for linear movement between adjacent ladders. They should be installed instead of standard couplers at regular intervals with their spacing being determined using manufacturer's guidelines
- 3 When expansion couplers are used, the ladder must be supported either side of the joint.

G Long spans:

- 1 Use long lengths of ladder or spans greater than 3m to avoid couplers.

Y63.3.5 PULLING OF CABLES

A Where cables are large or cable runs are long, their installation may require pulling tools in such cases the following is recommended:

- 1 On horizontal straight runs, the cables to ride on rollers mounted in or on the cable tray or cable ladder. These rollers should be properly spaced dependent on the size and weight of the cable to prevent the cable from sagging and dragging in the cable tray or cable ladder during the pull
- 2 Contact the cable manufacturer for information regarding proper roller spacing
- 3 On horizontal bends and vertical pulls, the cables are to run through rollers or pulleys to maintain a minimum bending radius. Rollers and pulleys must be of sufficient diameter to prevent pinching the

cable between the roller/ pulley flanges. Each cable will have a minimum bending radius that must be maintained to prevent damage to the cable

- 4 Due to the length of some cable pulls and the cable weight, a great deal of force can be applied to the pulleys on horizontal and vertical bends. These pulleys should be anchored to the structural steel and not to the cable tray or cable ladder due to the force that can be applied during pulling. Do not pull down on the horizontal rollers, as they are not designed for this purpose, and damage could result to the cable, cable tray or cable ladder.

Y63.3.6 INSTALLATION OF CABLES

- A Install cables only when the cable support installation is complete and inspected.
- B Cables should be fastened to the cable ladder and/or cable tray using cable cleats or cable ties to prevent movement of the cables under normal use and during fault conditions. Generally, the spacing between cable fastenings should not exceed the dimensions stated in BS 7671 and as indicated in table below.
- C For applications where the fault current level requires it, spacing between cable fastenings may be less than those indicated. Where this applies details should be obtained from the electrical supplier of the fastenings.

Maximum spacing of cable fastenings mm						
Overall diameter or max width of cable	Non- armoured thermosetting or thermoplastic sheathed cables		Armoured Cables		Mineral Insulated copper or aluminium sheathed cables	
mm	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
≤9	250	400	-	-	600	800
>9≤15	300	400	350	450	900	1200
>15≤20	350	450	400	550	1500	2000
>20≤40	400	550	450	600	-	-

- D For the spacing of supports for cables having an overall diameter exceeding 40 mm, the manufacturer's recommendation should be observed.
- E Cable cleats and cable ties should be correctly sized and only tightened enough to secure the cable without indenting the insulation sheath.
- F On vertical runs the fastenings must be able to withstand the forces exerted by the weight of the cable. The cable weight should be supported in such a manner as to prevent damage to the cable ladder, cable tray or cable.
- G Where possible it is best practice to position cable cleats on alternate rungs of the cable ladder in order to evenly spread the load along the length of the cable ladder.
- H For cables on horizontal tray use ties for each circuit. Use tie manufacturer's special tensioning tool where available. Crop off tie ends.
- I The following table indicates the maximum clamping capacity of various widths/lengths of cable tie

Maximum clamping diameter	2.5mm wide	3.6mm wide	4.8mm wide	7.6mm wide	9mm wide
mm	Cable Tie Length mm				
18	100				
30	120	140			
35		150			
40	200		188		
50		200	200		
60			250		
76		295	300	297	
102		370	368	368	
120					430
140					530
228					775

J Install cable cleats according to manufacturer's guidelines and comply with the following:

- 1 Cable cleats should always be installed at the beginning, middle and end of a bend, and at no time should the distance between cleats on a bend be more than 0.3m centre to centre
- 2 It is not necessary for every cleat to be attached to the tray. Every other cleat must be attached to the tray system to mount cable in tray. Unattached cleats provide additional restraint to keep cables bundled
- 3 Cable bend radius should be 8 to 12 times the cable diameter.

Y63.3.7 DATA CABLES

A Installation: There are rules that apply to the installation of all data cable bundles, regardless of containment type, and they are:

- 1 Cable ties must not be too tight. Any cable within a tied bundle must be able to be moved through that tie with slight resistance
- 2 Data and optical cables cannot stand the same heavy-duty 'lashing' as power cables. The tie must not be too thin as it may cut into the sheath of the cable
- 3 The minimum bend radius shall not be less than that specified by the cable manufacturer
- 4 Manufacturers generally specify six to eight times the cable diameter as the cable bend radius.
- 5 There is no exact or correct figure for the amount of cables allowed in any one bundle, typically a figure of between 24 and 48 cables is used.

B Segregation: Where power and data cables are installed within the same containment system or within close proximity to each other, suitable segregation shall be used. Comply with guidance in BS 6701 and BS EN 50174.

Y63.3.8 EXPANSION

A Cater for structural building and thermal movements with the application of expansion joints in cable trays/ladders. Use expansion couplers spaced to accommodate the maximum temperature differential which is likely to be encountered in the installation.

B Where expansion joints are present in the cable tray or cable ladder installation, provision must be made for the cable to expand and contract correspondingly. This is usually achieved with a loop in the cable at the expansion joint position.

Y63.3.9 EARTHING

- A Provide earthing to cable trays and bond each section together with proprietary earthing loops in accordance with BS 7671.

Y63.3.10 FIELD QUALITY CONTROL

- A After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:
- 1 Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage
 - 2 Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by BS 7671. Verify that communication or data-processing circuits are separated from power circuits by barriers
 - 3 Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables
 - 4 Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation
 - 5 Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and re-torque in suspect areas
 - 6 Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware
 - 7 Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all take-off raceways are bonded to cable tray.
- B Report results in writing.

Y63.3.11 PROTECTION

- A Protect installed cable trays:
- 1 Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer
 - 2 Install temporary protection for cables in open trays to protect exposed cables from falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials until the risk of damage is over.

Y63.3.12 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A Co-ordinate sleeve selection and application and provide fire-stopping in fire rated walls and floors. Refer to standard details.
- B Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C Use sleeves of the following types:
- 1 Galvanised steel pipe sleeves for metal conduits
 - 2 PVC sleeves for plastic conduits or insulated cables
 - 3 Rectangular metal sleeves for cable trays/ladder racks and baskets.
- D Rectangular Sleeve Minimum Metal Thickness:
- 1 For sleeve cross-section rectangle perimeter less than 1200 mm and no side greater than 400 mm, thickness shall be 1.3 mm
 - 2 For sleeve cross-section rectangle perimeter equal to, or greater than, 1200 mm and 1 or more sides equal to, or greater than, 400 mm, thickness shall be 3.5 mm.
- E Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with fire-stop system used are fabricated during construction of floor or wall.
- F Cut sleeves to length for mounting flush with both surfaces of walls.
- G Extend sleeves installed in floors 50 mm above finished floor level.

- H Size pipe sleeves to provide 5mm annular clear space between sleeve and conduit.
- I Seal space outside of sleeves with flexible mastic in non-fire rated walls or intumescent mastic in fire rated walls and floors.
- J Roof-Penetration Sleeves: Seal penetration of individual conduits with weatherproof flashing units applied in coordination with roofing work.
- K Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 25-mm annular clear space between pipe and sleeve for installing mechanical sleeve seals.

Y63.3.13 PENETRATIONS THROUGH FIRE WALLS AND FLOORS

- A** Always comply with manufacturer's details and instructions. Refer also to standard details and section Y90 of this specification. Ensure that any proposed installation will provide the fire rating of the intervening wall or floor.
- B** Fire stopping may comprise the following types. Use where indicated on the drawings:
 - 1 Intumescent pillows
 - 2 Trunking and tray compressible fire stop batts
 - 3 Multi-cable transits.
- C** For multi-service/large penetrations use:
 - 1 Fire stop boards/ablative batts: see Y90
 - 2 Fire stop mortar: see Y90.
- D Intumescent pillows:**
 - 1 Application: To seal up openings in walls and floors after the installation of electrical services in fire rated walls and floors. Use also to seal up the inside of tray or trunking passing through fire rated structures. Also use to fire stop inside trunking or to form cavity barriers under raised access floors. Suitable where many cables are to be installed or re-routed in the future
 - 2 Constraints: Check with particular manufacturer but typical constraints are:
 - a Steel & copper pipes: ≤ 100mm diameter
 - b Multi-core cables: ≤ 25mm diameter
 - c Multi-core signal PVC sheathed cables: ≤ 11mm diameter
 - d Data cables: ≤ 6mm diameter
 - e Perforated cable tray: carrying single cables (as above) or bunched in bundles, no more than 50mm overall diameter with each bundle separated by at least 40mm
 - f Steel trunking not exceeding 150 x 150mm (through floor seals only) containing single cables (as above) or bunched in bundles, no more than 50mm overall diameter with each bundle separated by at least 40mm. Remaining void within trunking should be fully sealed with Intumescent Pillows.
 - 3 Composition: sealed polythene or glass cloth bags contained within a glass fibre outer containing graphite and vermiculite/fillers granules that intumesce to provide a fire rated barrier for service penetrations in solid walls and floors and partition walls when packed into opening in layers.
 - 4 Testing:
 - a BS 476: Part 20:
 - b BS EN 1366-3:
 - 5 Fire resistance: up to 4 hours.
- E Trunking and tray compressible fire stop:**
 - 1 Application: To effectively seal cable bunches in electrical trunking and cable trays where they pass through fire rated walls and floors.
 - 2 Description: Cable Firestop is a compressible fire-retardant foam which is laminated both sides with a graphite based intumescent polymer. Supplied in sections measuring 60mm wide x 25-30 mm thick x 1m long.
 - 3 Testing:
 - a BS 476: Part 20:

- b BS EN 1366-3:
- 4 Fire resistance: up to 4 hours
- 5 Constraints:
 - a Suitable for copper cored / PVC sheathed and insulated power cables up to 12mm diameter, secured on perforated trays/ladders or within PVC trunking passing through both walls and floors
 - b Cables and trays must be supported within 500mm on both sides of the seal
 - c Maximum of 3 layers of cables, each layer sealed with the Multi-Cable Fire stop
 - d The aperture width cut from the Ablative Coated Batt should match the width of the cable tray (maximum 150mm) or PVC trunking (maximum 100mm)
 - e There must be a minimum of 100mm width of Ablative Coated Batt between the penetration and the edge of the main aperture within the supporting construction
 - f Maximum depth filled must not exceed 60mm
 - g For larger voids see Intumescent Pillows, Firestop Compound or Ablative Coated Batt.

F Intumescent Electrical Conduit

- 1 Application: To provide an effective 2-hour fire rated seal for cables routed in plastic conduit crossing a fire rated wall or floor
- 2 Description: Intumescent PVC compound with a 1mm thick PVC outer cover available for connecting to plastic conduits using appropriate couplers and available in the following sizes:

Outside Diameter	Min thickness of intumescent compound	Internal Diameter
mm	mm	mm
20	1.8	14.4
25	1.8	19.4

G Multi-cable transits

- 1 Applications; For sealing cables in the most critical applications whereas gas tight, watertight and fire resisting seal is required. Provide where indicated on the drawings. Use electro-magnetic conduction tolerant blocks if indicated necessary.
- 2 Manufacturers:
 - a Hawke Transit Systems
 - b < insert name >
- 3 Description: Modular system comprising cast in flanged steel combination frame installed flush to surface, zero halogen, intumescent elastomeric rubber polymer modules, wedge compression kit and lubricant. For EMC blocks use stainless steel frames.
- 4 Maximum seal size:
 - a single opening: 277 mm x 120 mm x 60 mm
 - b multiple opening: 504 mm x 562 mm x 60 mm.
- 5 Testing:
 - a BS 476: Part 20:
 - b BS EN 1366-3:
- 6 Fire resistance: up to 2 hours

Y65 ELECTRICAL ACCESSORIES

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Y65.1 PART 1- GENERAL

Y65.1.1 RELATED DOCUMENTS

- A Drawings and general provisions of the Contract, including main Contract Preliminaries and section A of this specification.
- B For performance details and physical characteristics of equipment refer to section D "Schedules of Equipment".
- C For accessory application selections schedules, operating parameters and ambient temperatures refer to section B of this specification and the layout drawings.
- D Refer also to the following sections:
 - 1 V30 "Low Voltage Distribution System"
 - 2 V31 "Low Voltage Switchgear"
 - 3 V80 "Electrical Identification"
 - 4 V81 "Earthing and Bonding Systems"
 - 5 Y50 Electrical Commissioning
 - 6 Y60 "Conduit and Trunking"
 - 7 Y63 "Cable Supports"
 - 8 Y67 "Transient over-voltage surge suppression devices"
 - 9 Y90 "Fixing to buildings".

Y65.1.2 SUMMARY

- A This Section includes the following electrical accessories:
 - 1 Switchplates General
 - 2 Standard Interior Lighting Switches
 - 3 Interior Switches (Europlate Type Modular)
 - 4 Modular Grid Switching Systems
 - 5 Waterproof and Dustproof Switches
 - 6 Ceiling Switches
 - 7 Toilet Call System
 - 8 Modular Lighting Connectors
 - 9 Plug-In Sockets and Ceiling Roses
 - 10 Luminaire Ceiling Roses and Pendants
 - 11 Lamp Holders
 - 12 TV/FM & Satellite Co-Axial Socket Outlets
 - 13 Dimmer Switches (Low Voltage)
 - 14 Time Switches
 - 15 Isolating Switches
 - 16 Telephone and Data Outlet Sockets - General Purpose
 - 17 Telephone Cord Outlets - General Purpose
 - 18 D Type Multi-Pin Connectors - General Purpose
 - 19 BNC Sockets - General Purpose
- B Refer to section V40 for the following small power accessory items:
 - 1 Small Power outlets and accessories for:
 - a Socket Outlets
 - b RCD Protected Socket Outlets
 - c Isolated Power Supply
 - d Filtered Socket Outlets
 - e Three Pole Fan Isolators

- f Shaver Socket Outlets
- g Fused Connection Units and Flex Outlets
- h Key Operated Switch Isolator
- i High Current Switches and Cooker Control Units
- j Underfloor Busbar Systems
- k Raised Floor Outlet Boxes
- l External Socket Outlet Pits
- m Marina Pedestal Outlets
- n Electric Heating
- o Hand Dryer Air Blade Type
- p Hand Dryer Compact Downflow Type
- q Trace Heating

C Refer to section Y60 for the following LV trunking and accessory equipment:

- 1 Metal Distribution Trunking
- 2 Lighting Trunking
- 3 PVC Distribution Trunking
- 4 Steel Perimeter Trunking Systems
- 5 PVC Perimeter Trunking
- 6 Underfloor Trunking - Flush Lid – No Service Outlets
- 7 Buried "In Screed" Floor Trunking
- 8 Raised Floor Trunking Systems
- 9 Service Outlet Boxes Raised Access Floors
- 10 Service Outlet Boxes for Screeded Floors
- 11 Service Poles & Posts
- 12 Trunking Supports and Fixings

Y65.1.3 DEFINITIONS

A Some of the following terms are used in this section:

- 1 Tap-Off Unit: An outgoing unit for tapping off power from a busbar trunking system.
- 2 Pigtail: Short lead used to connect a device to a branch-circuit conductor.

B The following acronyms are used in this specification:

- 1 A.C.: Alternating Current
- 2 BH: Buro Happold
- 3 Low Voltage (LV): Voltage
 - a A.C.: $\geq 50V$ and $\leq 1000V$ or $600V$ between conductors and earth
 - b D.C.: $1500V$ between conductors or $900V$ between conductors and Earth
- 4 IP: Ingress Protection to BS EN 60529 and defines protection against solid objects and separately against moisture
- 5 IET: institution of Engineering and Technology
- 6 UPS: Uninterruptible Power Supply
- 7 RCD: Residual Current Device to quickly disconnect current to prevent serious harm to personnel.
- 8 SP: Single Pole
- 9 DP: Double Pole
- 10 TP: Three Pole
- 11 TPN: Three Phase and Neutral.
- 12 LED: Light-emitting Diode
- 13 PE: Protective Earth
- 14 CE: European Conformity
- 15 CAT 6: A Cat 6 cable is used mainly for computer networks reaching a Gb, 1000 Mbps or one Gbps of data transfer speed (DTR) or higher. Characteristics are as follows:

- a Consists of four pairs of copper wires, which are all utilized for data transfer
- b Provides bandwidth of 250 MHz, speed up to 10 Gbps and may be stretched to 100 meters in length
- c Provides more enhanced crosstalk and attenuation protection than its previous twisted pair cable versions.

16 CPC: Circuit Protective Conductor.

17 BC: Bayonet Connection.

18 ES: Edison Screw.

Y65.1.4 PERFORMANCE REQUIREMENTS

- A The Electrical Installation to be designed, installed, tested, commissioned and certified in full compliance with the IET Wiring Regulations (BS 7671). Section B of the specification identifies the coverage (no. of telephone/data outlets per m²) and type of switching for lighting systems.
- B Refer also to electrical Schedule "B2 Specification Electrical Room Data sheet" which indicates the provision of power, data and telecoms outlets on a room by room basis.
- C Section B of the specification also provides the project specific information and the scope of service including.:
- 1 External design conditions
 - 2 Internal design conditions
 - 3 Electrical Design Parameters
 - 4 Type of containment systems to be used
 - 5 Spare capacity
 - 6 Type of cabling to be used
- D The following design criteria also forms the basis for the design of the electrical installations.
- 1 Method of protection against electric shock: Earthed equipotential bonding and automatic disconnection of supply.
 - 2 Basis of calculation: Impedance criteria to be used are the tables from the IET regulations.
 - 3 Ambient temperature to be used for calculations: +30°C minimum.
- E All wiring accessories should be suitable for the local environment to ensure that suitable precautions (IP ratings) are made for sockets in kitchens, laboratories, plantrooms, general circulation spaces and for external locations.
- F Always refer to the schedule Y65 and the architectural specification/schedules for confirmation of appropriate finishes for all electrical outlets and accessories. Where no other requirements are stated or indicated provide general finishes for accessories of the following types/finishes:
- | | |
|---|--------------------------------------|
| 1 General hotel/ commercial/retail areas: | White PVC recessed |
| 2 Hospital/Medical: Group 0 & 1 areas: | White anti-bacterial PVCu |
| 3 Hospital/Medical: Group 2: | Special purpose colour-antibacterial |
| 4 Clinical risk cat 3 and higher: | |
| a to provide increased mechanical protection. | Metalclad |
| b to limit electromagnetic interference | Metalclad |
| 5 Commercial Areas: | White PVCu /polycarbonate |
| 6 Retail areas: | White PVCu/polycarbonate |
| 7 Industrial areas: | Metal clad surface mounted |
| 8 Plantrooms: | Metal clad surface mounted |
| 9 Kitchen/food processing: | Stainless steel recessed |
- G Refer to section B and room data schedules for the type of switching/lighting control to be provided.

Y65.1.5 SUBMITTALS

- A Product Data: Provide samples of all wiring accessories to the CA for approval prior to ordering. Samples of each type of finish to be provided with details of installation requirements.
- B Shop Drawings: Builderswork requirements for installation and fixing of all accessories including details of fire stopping when installed in fire rated walls. Refer to BH standard details.
- C Field quality control test reports.
- D Operation and Maintenance Data: Details of all products to include manufacturer's instructions and installation requirements.

Y65.1.6 QUALITY ASSURANCE

- A Electrical Components, Devices, and Accessories: Listed and labelled as defined in relevant British and Local Standards. Comply with the requirements of the local Wiring Regulations and associated Guidance Notes.
- B Ensure that the design, construction, materials and finishes of all equipment are suitable for the location, climatic and operating conditions to which the installation shall be exposed.
- C Ensure that the whole installation complies with the relevant standards, including the following:
 - 1 BS 67: Specification for ceiling roses
 - 2 BS 546: Specification. Two-pole and earthing-pin plugs, socket-outlets and socket-outlet adaptors (including Supplement No. 1 Specification for plugs made of resilient material)
 - 3 BS 1363 -2: 13 A plugs, socket-outlets, adaptors and connection units. Specification for 13 A switched and unswitched socket-outlets
 - 4 BS 1363-4+A4: 13 A plugs, socket-outlets and adaptors. Specification for 13A fused connection units switched and un-switched
 - 5 BS 3041-7:1996, IEC 60169-7: Radio-frequency connectors. R.F. coaxial connectors with inner diameter of output conductor 9,5 mm (0,374 in) with bayonet lock. Characteristic impedance 50 ohms (Type
 - 6 BS 4662+A1 - Boxes for flush mounting of electrical accessories. Requirements, test methods and dimensions
 - 7 BS 5733 + A1: General requirements for electrical accessories. Specification
 - 8 BS 6312-1: Connectors for analogue telecommunication interfaces. Specification for plugs
 - 9 BS 6312-2.1: Connectors for analogue telecommunication interfaces. Sockets for use with plugs specified in BS 6312- 1. Specification for sockets. General requirements
 - 10 BS 6312-2.2: Connectors for analogue telecommunication interfaces. Sockets for use with plugs specified in BS 6312-1. Particular requirements for fixed socket-outlets used in permanent wiring installations
 - 11 BS 6972: Specification for general requirements for luminaire supporting couplers for domestic, light industrial and commercial use
 - 12 BS 7001 - Specification for interchangeability and safety of a standardised luminaire supporting coupler
 - 13 BS 7671: +A3: Requirements for Electrical Installations. IET Wiring Regulations
 - 14 BS 7895 - Specification for bayonet lamp holders with enhanced safety
 - 15 BS 8300: +A1: Design of buildings and their approaches to meet the needs of disabled people. Code of practice
 - 16 BS EN 41003: Particular safety requirements for equipment to be connected to telecommunication networks and/or a cable distribution system
 - 17 BS EN 50083-2: +A1: Cable networks for television signals, sound signals and interactive services. Electromagnetic compatibility for equipment
 - 18 BS EN 50173-1: Information technology. Generic cabling systems. General requirements
 - 19 BS EN 55014-1: + A2: Electromagnetic compatibility. Requirements for household appliances, electric tools and similar apparatus. Emission
 - 20 BS EN 55015:2+A1: Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment

- 21 BS EN 60064: +A5: Tungsten filament lamps for domestic and similar general lighting purposes. Performance requirements
- 22 BS EN 60238+A2 - Edison screw lamp holders
- 23 BS EN 60529 + A2 - Specification for degrees of protection provided by enclosures (IP code)
- 24 BS EN 60669-1+A2 - Switches for household and similar fixed electrical installations. General requirements
- 25 BS EN 60669-2-1: +A12: Switches for household and similar fixed electrical installations. Particular requirements. Electronic switches
- 26 BS EN 60669-2-3: Switches for household and similar fixed electrical installations. Particular requirements. Time delay switches (TDS)
- 27 BS EN 60730-2-7 - Specification for automatic electrical controls for household and similar use. Particular requirements. Timers and time switches
- 28 BS EN 61184+A1 - Bayonet lamp holders
- 29 ISO/IEC 11801:(CONS-2-1) Information technology. generic cabling for customer premises

Y65.1.7 DELIVERY, STORAGE, AND HANDLING

- A Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Protect equipment from exposure to dirt, fumes, water, corrosive substances, and physical damage.

Y65.1.8 CO-ORDINATION

- A Coordinate layout and installation of electrical accessories with other elements the construction including HVAC equipment, fire-suppression system, door swings and partition/wall constructions.

Y65.1.9 EXTRA MATERIALS

- A Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B Each type of wiring device: One for every 20 devices.

Y65.2 PART 2 – PRODUCTS

Y65.2.1 MANUFACTURERS

- A Products: Subject to compliance with requirements: provide products sourced from one of the following manufacturers or as indicated in equipment schedules and drawings that form part of this specification.
- 1 Legrand
 - 2 MK Electric
 - 3 Wandsworth
 - 4 Electrium (Crabtree)
 - 5 Crestron
 - 6 An alternative manufacturer's equipment may be submitted for approval.
- B Source Limitations: Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source. In general, unless indicated otherwise, the specific manufacturer's ranges/styles provided for power sockets (where exposed to view) in V40 should match the other wall mounted accessories indicated in this specification.

Y65.2.2 SWITCHPLATES GENERAL

- A Switchplates may take one of the following forms. Refer also to the Y65 schedule (if provided) which indicates the location and types of switch plates to be used:
- 1 Standard (Traditional)
 - 2 Modular Europlate with inserts
 - 3 Grid type with modular inserts
- B Installation to be flush or surface as indicated in specification section B, the equipment schedules and the drawings. Where not indicated comply with the following:
- 1 Occupied areas: Flush built into wall structures
 - 2 Plantroom areas: Exposed metal clad type, surface mounted on walls
 - 3 Factories/warehouses/storage: Exposed metal clad type surface mounted on walls
 - 4 Plantrooms: Exposed metalclad surface mounted
 - 5 Service tunnels/roof voids: Exposed metal clad surface mounted
- C Standard type back boxes enclosures: For the containment of wiring terminations to be of the following types depending upon the installation:
- 1 Flush mounting in masonry walls: BS 4662
 - a Galvanised steel
 - b Depths: 25,35,47, 55, 65mm to suit installation
 - 2 Flush mounting in dry lined walls: BS 4662
 - a Moulded white thermoset plastic
 - b Depth: 35mm
 - c Pre-fitted with intumescent gaskets to give fire protection, in accordance with BS 476 Pt.22: 1987. The void behind the wiring device will be filled to provide protection against the passage of fire.
 - 3 Surface mounting: BS 5733:
 - a Moulded white thermoset plastic:
 - Depths: 16,32,40,44mm to suit installation:
 - b Metal clad (grey epoxy coated steel)
 - Depths: 41,48,
 - 4 All boxes to have:
 - a Earth terminal fitted
 - b Knock outs on all sides and rear suitable for conduit installations

- c Box dimensions to suit the front plate and wiring installations
- D Modular Europlate Back boxes: As detailed for standard type
- E Modular Grid back boxes: For the containment of wiring terminations to be of the following types depending upon the installation: BS EN 60669-1 with back boxes to BS 4662
 - 1 Flush mounting in masonry walls:
 - a Moulded aluminium
 - 2 Surface mounting
 - a Stove enamelled aluminium
 - 3 All boxes to have:
 - a Adjustable plated steel Grid frame (screwed to back box) for fixing front plate
 - b 16mm² earth terminal
 - c Knock outs on all sides and rear suitable for conduit installations
 - d Box dimensions to suit the front plate and wiring installations
- F Wiring boxes should not be less than the following

Y65.2.3 STANDARD INTERIOR LIGHTING SWITCHES

- A Standard Plate Switches: Application General Domestic and commercial lighting switching operations. Suitable for installation in plaster depth boxes. Where indicated can be provided with a neon indicator providing a surrounding green glow for ease of location.
- B Manufacturers: Provide as indicated on the schedules of equipment: Y65 or where not indicated select from one of the following:
 - 1 MK Electric: Logic Plus /Aspect / Elements
 - 2 Legrand: Synergy Modern, & Traditional / Metalclad
 - 3 Crabtree: Capital, Platinum
 - 4 Wandsworth: Classic
- C Construction
 - 1 Material: Switch plates can be provided in the following finishes: Provide finish as detailed on schedules and refer also to the architectural schedules.
 - a White polycarbonate/
 - b Silver
 - c Nickel
 - d Brushed Stainless Steel
 - e Polished Stainless steel
 - f Metal Clad (grey epoxy coated steel)
 - 2 Standard - BS EN 60669-1+A2, enclosure box in accordance with BS 4662+A1 with the following options:
 - a Red LED power on indicator
 - b Green LED locator surround
 - 3 Switch type:
 - a Rocker bar
 - b Switch rocker bar colour - contrast from plate colour as BS 8300+A1
 - 4 Rating - 10A or 20A: Depending on load requirements
 - 5 Switching arrangements as indicated
 - a 10A Single pole Plate switches
 - 1 Gang 1 way
 - 1 Gang 2 way
 - 2 Gang 2 way
 - 1 gang intermediate
 - 3 Gang 2 way

- 4 Gang 2 way
- 6 Gang 2 way
- b 20A Single Pole plate switches
 - 1 Gang 1 way
 - 1 Gang intermediate
 - 1 Gang 2 way
 - 3 Gang 2 way
- c 10A Single Pole push switches:
 - 1 Gang 2 way
 - 1 Gang 2way marked "PRESS"
- d 10A Single Pole Key Switch:
- e Dimmer Switches: Rotary dimming and push on/off
 - Standard Type: Suitable only for GLS tungsten filament lamps only
 - Intelligent Dimmer: For use with dimmable wire wound or electronic Low Voltage Transformers of good quality. Can also be used with good quality mains voltage halogen lamps incorporating GU10 bases.
- 6 Terminal Capacity
 - a 4 x 1mm²
 - b 4 x 1.5mm²
 - c 3 x 2.5mm²
 - d 2 x 4mm²
 - e 1 x 6mm²
- 7 Switch mechanism – Positive with 3mm switch contact gap.
- 8 IP Rating: IP2XD
- 9 CE marked

Y65.2.4 INTERIOR SWITCHES (EUROPLATE TYPE MODULAR)

- A Modular Switches: Application for hotels and commercial premises where a range of technical features is required. Also used for assisted living spaces where large rocker/contrast colour frames is helpful and where required to comply with Part M of the Building Regulations. Where indicated can be provided with a neon indicator providing a surrounding green glow for ease of location. Modular inserts for other functions.
- B Manufacturers: Provide as indicated on the schedules of equipment: Y65 or where not indicated select from one of the following:
- 1 MK Electric: Logic Plus/Aspect/Elements/Albany Plus/Edge
 - 2 Legrand: Arteor, Clipper
 - 3 Crabtree: Capital Part M
- C Construction: Assembly comprising:
- 1 Module mounting frame, with fascia plate surround and modular multi- function inserts
 - 2 Standard - BS 5733 for the following configurations:
 - a 1G Euro front plate for 1 module: Aperture size 25x50mm
 - b 1G Euro front plate for 1, 2 or 3 modules: Aperture size 50x50mm
 - c 2 G Euro front plate for 4 modules: Aperture size: 100x50mm
 - d 3 G Euro front plate or 6 modules: Aperture size: 150x50mm
 - 3 with the following options: provide where indicated on the schedule
 - a Green Neon locator surround (for Part M use)
 - b Silver surround frame
 - 4 Large Rocker types: provide where indicated on the schedule
 - a use 50mmx50mm aperture and wide rocker bar for part M compliance
 - b use neon locator where indicated on the schedules
 - 5 Finishes: Plate and rocker bar combination to be:

- a White moulded plastic plate/rocker bar moulded plastic
- b Grid moulded plastic plate/rocker bar moulded plastic
- c Metal Clad plate/ rocker bar moulded plastic, contrast from plate colour as BS 8300+A1
- d Brushed stainless steel plate/rocker bar white
- 6 Lighting switches: Gangs available and as indicated: BS EN 60669-1
 - a 10A Single pole large rocker plate switches
 - 1 Gang 2 way
 - 2 Gang 2 way
 - 1 gang 2 way intermediate
 - 3 Gang 2 way
 - b 10A Single Pole push switches:
 - 1 Gang 2 way
- 7 Physical:
 - a IP Rating: IP2XD
 - b Switching: 3mm switch contact gap
 - c CE marked
- 8 Other Modules for insertion:
 - a Dimmer Switches: BS EN 60669-2-1 & BS EN 55014-1
 - b Neon grid modules: BS 5733
 - c Hotel switches:
 - Key card Switch: BS EN 60669-2
 - 10A "Make up Room" and "Do not disturb" switch
 - 10A service indicator & bell push
 - d Communication outlets: BS5733
 - BT master
 - BT secondary (6 wire)
 - RJ145, 8 wire, Cat 6
 - RJ11/12
 - TV outlet Male/female
 - F type satellite
 - Triplex unit: TV, FM Sat
 - Phono
 - USB dual 2 x 1A 5V data
 - USB single 2A 5V data

Y65.2.5 MODULAR GRID SWITCHING SYSTEMS

- A A modular switching and monitoring multifunction wiring device system. Modular grid systems are generally to be used when there is a need to install more than 6 gang switches or where there is a need to incorporate a number of different functions on one plate.
- B Manufacturers: Provide as indicated on the schedules of equipment: Y65 or where not indicated select from one of the following:
 - 1 Legrand: Synergy Grid System
 - 2 MK Electric: Grid Plus
 - 3 Crabtree: Modular Grid System
- C Modules to have a simple 'clip fit' mechanism to hold them to the mounting frame, which do not require specialist tools and are fitted in to place from the front. Refer to Schedule Y65 for specific manufacturer's range to be employed or equal and approved.
- D Switching modules incorporate standard rocker type switches. Modules may comprise a combination of the following types of devices:
 - 1 10A Single Pole switch modules

- a 1 way
 - b 1 way + red LED power indicator
 - c 2 way
 - d Intermediate
- 2 20A Single Pole switch modules
 - a 1 way
 - b 1 way + red LED power indicator
 - c 2 way
 - d 2 way retractive centre off
 - e 2 way retractive centre off with up & down arrows
 - f 2 way push switch
 - g Intermediate
- 3 10A Single Pole Push Fit
 - a 2 way push
 - b 2 way push marked "PRESS TO EXIT"
 - c 2 way push switch marked "BELL"
- 4 20A Single Pole Key Switch
 - a 2 way key switch
 - b 2 way key switch retractive centre off
 - c Intermediate switch
- 5 20A Double Pole Switch modules
 - a Switch
 - b Switch + red LED power indicator
 - c Push to make/push to break
- 6 20A Double Pole key switch modules
 - a Key switch
 - b Key switch marked "EMERGENCY LIGHT TEST"
 - c Key Switch + red LED power indicator
- 7 Printed Modules (BS EN 60669-1) with and without neon: Typical printed indications include
 - a Boiler, Dishwasher, Cooker Hood, Fan, Fridge, Freezer, washing machine, tumble dryer,
 - b Microwave, Heater, Oven, Hob, immersion heater, plinth heater, worktop lighting,
- 8 Indicator modules: Following types available to BS 5733
 - a Neon: Red or amber 200-250V
 - b Fluorescent: Green 200-250V
 - c Filament: Red, Green or Amber 21-36V
 - d LED: red or Green
- 9 Dimmer switches for low voltage, fluorescent or LED lighting
 - a Standards: BS EN 60669-2-1, BS EN 55015
 - b Low voltage/tungsten filament:40-300W
 - c Fluorescent controller: 0-10V 400W
 - d LED intelligent controller
- 10 Time Delay Switch:
 - a Standard: BS EN 60669-2-3
 - b Multiple way soft start time delay switch 40-400W
 - c Pre-sets: 3,10 or 30 minutes
- 11 Ancillary and Communication modules:
 - a Telephone socket master: BS 6312-2
 - b Telephone socket secondary: BS 6312-2
 - c RJ 45 Data Outlet CAT 6 compliant: ISO/IEC 11801
 - d Screened TV single 9.5mmØ
 - e Screened Satellite
 - f HiFi outlet-screw terminal
 - g Cable Outlet
 - h Blank module

- i Buzzer unit
- j Fuse unit

E Modules can be formed into gridded face plates of the following dimensions and configurations:

- 1 86mm x 86 mm: 1, 2 modules
- 2 146mm x 86mm: 3, 4 modules
- 3 146mm x 146mm: 6, 8 modules
- 4 146mm x 205mm: 9, 12 modules
- 5 205mm x 205mm: 18 modules
- 6 205mm x 265mm: 18, 24 modules

F Module inserts can be of the following colours. Refer to schedules for colour of modules. Where not indicated use:

- 1 White surround plate with black module to comply with the visual contrast requirements of Part M of the Building regulations
- 2 White insert: for most general and commercial applications
- 3 Red insert: for special purposes

G Accompanying front plates must be able to hold up to 24 modules in a variety of aesthetics and finishes as indicated on the schedules.

- 1 Brushed stainless Steel
- 2 Polished Brass
- 3 Silver Anodised Aluminium
- 4 Polished chrome
- 5 White
- 6 Black Anodised Aluminium
- 7 Matt Chrome
- 8 Polished Bronze
- 9 Antique Bronze
- 10 Brushed Brass
- 11 Satin Brass
- 12 Gold Plate

Y65.2.6 WATERPROOF AND DUSTPROOF SWITCHES

A Waterproof & Dustproof Switch: Application

- a Interior: Plant Areas, Service Tunnels, swimming pools or anywhere accidental spraying of water and/or dust could occur.
- b Exterior: Gardens, farm buildings

B Manufacturers: Provide as indicated on the schedules of equipment: Y65 or where not indicated select from one of the following:

- 1 Legrand: Plexo
- 2 MK Electric: Masterseal Plus
- 3 Crabtree: Weatherseal

C Construction: Switches designed for surface mounting or flush mounting. Switches can be of the single large rocker type or grid type for using with plug in modules. Grid type with sealed openable hinged lid.

- 1 Material: Switch enclosure
 - a Grey, white or black UV protected polycarbonate
- 2 Standards
 - a BS EN 60669-1
- 3 Load Rating: 10A or 20 A

- 4 IP Rating: BS EN 60529
 - a Standard Single Switches: IP 66
 - b Grid Switches: IP 56
- 5 with the following options:
 - a Green Neon locator surround
 - b Silver surround frame
- 6 Switch type:
 - a Standard single switch: Large Rocker bar
 - b Grid type: Up to 2 wiring modules may be incorporated
- 7 Mounting:
 - a Rear entry back boxes for surface mounting
 - b Rear entry boxes + flush mounting bezel for recessed installations
- 8 Standard Gangs available and as indicated
 - a 10A Single pole large rocker plate switches
 - 1 Gang 1 way
 - 1 Gang 2 way
 - 2 gang 1 way
 - b 10A Single Pole push switches:
 - 1 Gang 1 way
 - c 10A Single Pole push switches: Push to make or push to break
 - 1 Gang 2 way engraved "BELL"
 - 1 Gang 2 way engraved "PRESS"
 - d 20A Double Pole push switches:
 - 1 Gang 1 way engraved "PRESS"
- 9 Grid modules: 1 or 2 gang inserts
 - a 10A switches
 - 1 gang 1 way SP
 - 1 gang 2 way SP
 - 1 gang 1 way DP
 - b 20 A switches
 - 1 gang 1 way SP
 - 1 gang 2 way SP
 - 1 gang intermediate
 - 1 gang 1 way DP
 - c Neon: Red
 - d Data outlet
 - e Telephone outlet

Y65.2.7 CEILING SWITCHES

- A Pull cord switch for flush mounting ratings:
 - 1 6A SP one way or 2 way
 - 2 16A DP one way
 - 3 50A DP one way with red neon and mechanical Off indicator
- B Construction: Flush Ceiling mounted for use with mounting block having an earth terminal riveted into the base complete with pull cord with standard acorn type pulls or grip ring pulls for use in part M compliant accommodation.
 - 1 Material: Switch plates: White polycarbonate
 - 2 Standard - BS EN 60669-1+A2, Options include:
 - a Red LED power ON indicator
 - b Mechanical "OFF" indicator

- 3 Switch type: Pull cord Retractive (momentary) switch action which can be wired as either pull to make or pull to break. Cord Options:
 - a White cord: 1.5m with white acorn pull
 - b White cord: 2.0m with grey coloured grip ring pull
 - c Red cord: 2.0m with 2 x red grip ring pulls
 - d Red cord: 3.0m with 2 x red grip ring pulls
- 4 Terminal Capacity
 - a 6A: 4 x 1mm², 3 x 1.5mm²
 - b 16A: 4 x 2.5mm², 2 x 4.0mm², 1 x 6mm²
 - c 50A: 4 x 4mm², 3 x 6mm², 1 x 10mm², 1 x 16mm²
- 5 Mounting box Earth terminals: 6 x 1mm², 4 x 1.5mm², 2 x 2.5mm², 1 x 4mm², 1 x 6mm²
- 6 Switch mechanism – Positive with 3mm switch contact gap.
- 7 IP Rating: IP3X
- 8 CE marked

Y65.2.8 TOILET CALL SYSTEM

- A Toilet Call system designed to DDA requirements and BS8300 comprising 3 parts:
- 1 Pull cord unit
 - 2 Reset Unit
 - 3 Overdoor Lamp/sounder/PSU
- B Unit to be white moulded thermoplastic or brushed stainless steel as indicated
- C Where indicated interface the unit with a centralised Disabled call refuge system.
- D Pull cord to be red/orange and long enough to reach floor level. Pull cord unit supplied with 2 red plastic grip ring pulls to conform with Approved document M.
- E Activating a call is made by pull the cord which activates the re-assurance LED indicator on the pull cord unit, which illuminates the reset unit and triggers the internal sounder. At the same time the overdoor LED indicator/sounder will illuminate and trigger its own internal sounder. When a call is activated the reset switch illuminates and the internal sounder activates. Call is reset by pressing the switch.
- F Reset unit is engraved "RESET" and supplied with Braille legend on the switch piece.
- G The overdoor indicator/sounder has an integral power supply unit. Provide an adjacent fused spur to power the unit.

Y65.2.9 MODULAR LIGHTING CONNECTORS

- A Description: A connection and distribution system comprising modular plug and socket interface units permitting luminaires to be plugged in without isolating the circuit. All live contacts are inaccessible, and the earthing contact is made before any other.
- B Manufacturers:
- 1 MK Electric
 - 2 Hager
- C Distribution boxes: Extruded aluminium box with V0 rated plastic terminal housing suitable for 3 and 4 pin plugs complete with 20 or 25mm conduit entries in top, bottom and back of box.
- 1 Standards: BS 5733
 - 2 Main terminal rating: 16A (3x6mm²)
 - 3 Socket outlet rating: 6A
 - 4 Separate terminals for flexible conductors: 10A
 - 5 Number of Ways: 4,6,8,10 or 12

Y65.2.10 PLUG IN SOCKETS AND CEILING ROSES

A Description: For use with modular lighting system. A plug-in ceiling rose is used to offer a pluggable connection for luminaires. The luminaire can be safely connected and disconnected under load.

- 1 Standards: Complies with BS 6972 and BS 5733
- 2 Sockets: 4 terminations: line, neutral, earth and loop-in
- 3 Support capability: max 5kg

B Plug-in Socket outlet options:

- 1 3 Pin Socket: Ceiling type suitable for 3 pin plug
 - a Dimensions: 75mm diameter x 7mm deep
 - b Terminals: 5x1.0mm², 4 x1.5mm², 3x2.5mm², 2 x 4.0mm²
- 2 3 Pin Socket: Architrave Type suitable for 3pin plug
 - a Dimensions: 86x33mm x 6mm deep
 - b Terminals: 5x1.0mm², 4 x1.5mm², 3x2.5mm², 2 x 4.0mm²
- 3 4 Pin Socket: Square type suitable for 3 or 4 pin plugs
 - a Dimensions: 86 x86mmx 9mm and 5mm deep
 - b Terminals: 5x1.0mm², 4 x1.5mm², 3x2.5mm², 2 x 4.0mm²
- 4 4 Pin Socket: Circular type (BESA)
 - a Dimensions: 75mm diameter x 7mm deep
 - b Terminals: 5x1.0mm², 4 x1.5mm², 3x2.5mm², 2 x 4.0mm²

C Ceiling Rose options:

- 1 3 Pin plug-in Ceiling Rose: Complete with socket, 3 pin plug and cover
 - a Dimensions: 75mm diameter x 44mm cover and 7mm fitting depth
 - b Terminals: 5x1.0mm², 4 x1.5mm², 3x2.5mm², 2 x 4.0mm²
 - c Plugs: 3 terminations (line, neutral, and CPC)
- 2 4 Pin with auxiliary plug-in Ceiling Rose: Complete with socket, 4 pin plug and cover
 - a Application: typically used for emergency lighting
 - b Dimensions: 75mm diameter x 44mm cover and 7mm fitting depth
 - c Terminals: 5x1.0mm², 4 x1.5mm², 3x2.5mm², 2 x 4.0mm²
 - d Plugs: Red colour, 4 terminations (line, neutral, CPC and auxiliary)

Y65.2.11 LUMINAIRE CEILING ROSES AND PENDANTS

A General and Emergency Lighting:

- 1 Rating - 2A
- 2 Connector type - Fixed terminal strip, screw cover and cord grip in accordance with BS 67
- 3 Load carrying capacity to match selected luminaire.

B General Lighting:

- 1 Rating - 2A
- 2 Connector type - 3 pin plug/socket in accordance with BS 546
- 3 Load carrying capacity to match selected luminaire.

C Cord Grip General and Emergency Lighting:

- 1 Rating - 2A
- 2 Connector type - Cord grip type plug / socket and screw on retaining cover in accordance with BS 5733
3 pin or 4 pin
- 3 Luminaire supporting coupler in accordance with BS 7001
- 4 Load carrying capacity to match selected luminaire.

Y65.2.12 LAMP HOLDERS

A BC Type:

- 1 Standard - BS EN 61184
- 2 Lamp holder type - Bayonet clip - B22
- 3 Fixing - Bracket - straight or angle, or suspension as indicated
- 4 Finish - Manufacturer's standard
- 5 Material - Heat resistant moulded plastic
- 6 Ancillaries:
 - a Cord grip, lampshade ring or protective lampshade ring as indicated.

B ES Type:

- 1 Standard - BS EN 60238
- 2 Lamp holder type - Edison screw - E27
- 3 Fixing - Bracket - straight or angle, or suspension as indicated
- 4 Finish - Manufacturer's standard
- 5 Material - White Heat resistant moulded plastic
- 6 Ancillaries:
 - a Cord grip, lampshade ring or protective lampshade ring as indicated.

C BC Type with Enhanced Safety:

- 1 Standard - BS EN 61184+A1 and BS 7895
- 2 Lamp holder type - bayonet clip B22
- 3 Fixing - Bracket - straight, or angled, or suspension, as indicated
- 4 Finish - manufacturer's standard
- 5 Ancillaries:
 - a Cord grip, lamp shade ring, and protective lampshade ring as indicated.

Y65.2.13 PIR SENSORS

A Provide where indicated on the drawings. Provide dual flush/surface mounted types where personnel presence is detected by passive infra red technology: Performance and construction to comply with the following:

- 1 Coverage: 360°
- 2 Detection Range: Up to 6 metres diameter (3m radius) at mounting height of 2.5m
- 3 Operating Voltage: 220 – 240VAC / 50 Hz
- 4 Delay time: 5 seconds to 15 minutes
- 5 Load Rating: 6A
- 6 Operating Temperature: 0° C - 40° C
- 7 LUX Level adjustment: 5 to 1000 LUX
- 8 Fascia Colour White: (RAL9010)
- 9 Material Flame retardant: PC/ABS
- 10 IP Rating:
 - a Surface mount: IP44
 - b Flush mount: IP44 (Sensor section only)
 - c Ceiling board onwards: IP20
- 11 Approvals Conforms to latest directives

B Provide units which have the ability to wire more than 1 sensor in parallel to a load and to switch volt free loads

C Provide units with:

- 1 a manual on/off override function.
- 2 a lens mask where necessary to mask out any areas of unwanted detection.

- D Mounting: Units can be flush or surface mounted.
- 1 Flush mounted: spring clips for ceilings 5-20mm thick
 - 2 Surface mounted: fixed direct to ceiling or if required onto a circular conduit or BESA box.
- E Physical Details:
- 1 Nominal Dimensions: 100x100mm
 - 2 Lens protrusion: 22 mm
 - 3 Surface mount height (including lens): 67mm

Y65.2.14 TV/DAB & SATELLITE SOCKET OUTLETS

- A Single, double triple or quadruple outlets for connection to a single TV or multiple outlets including FM/DAB and Satellite signals.
- B Telephone outlets to be provided as follows:
- 1 Construction:
 - a Standard plate type 86x86mm plate for flush or surface mounting
 - b Euro modules: 25 x50mm for incorporation into modular systems
 - 2 Configuration
 - a 1 Gang master
 - b 1 Gang secondary
 - c 1 Gang RJ11
 - 3 Standards:
 - a BS 6312 Pt 2
 - b BS 5733
 - 4 Cables: CW1311, CW1293, CW 1308, CW1316
- C TV /FM/SAT Sockets: Fully screened non isolated TV Outlets suitable for TV, Digital Radio (DAB), Satellite TV with additional secondary telephone outlet:
- 1 Construction:
 - a Standard plate type 86x86mm plate for flush or surface mounting
 - b Euro modules: for incorporation into modular systems
 - Single module: 25mm x50mm
 - Double module: 50mm x 50mm
 - 2 Possible outlet configurations
 - a Single TV Outlet
 - b TV/FM Diplexer
 - c TV/FM-DAB/SAT Triplexer
 - d TV/FM-DAB/2 x SAT Triplexer
 - e Additional Secondary telephone outlet if required
 - f Ancillaries: Safety isolation to CAI recommendations for communal aerial systems.
 - 3 Standards:
 - a BS 6312 Pt 2
 - b BS 5733
 - c BS EN 50083
 - d BS 60169-24
- D Finish:
- 1 Standard White PVC/polycarbonate
or
 - 2 To match finish used for other accessories from manufacturer's ranges

Y65.2.15 DATA OUTLETS

- A Data modules for incorporation into standard modular and euro modular suitable for structured cabling distribution systems.
- 1 Outlet types:
 - a RJ45 CAT 5e
 - b RJ45 CAT 6
 - c RJ11: 4 Wire
 - d RJ12: 6 wire
 - 2 Standards
 - a ISO/IEC 11801
 - b BS EN 50173
 - c TIA 568
 - d BS EN 41003

Y65.2.16 DIMMER SWITCHES (LOW VOLTAGE)

- A Application: For any application it is necessary to match the rating of the switch to the load and to match the dimmer switch type to the lamp type. Check details with lamp manufacturer and dimmer manufacturer so that they are compatible. Always comply with manufacturer's instructions.
- B Preferred Dimmer Construction and operation: Standard 86x86 x45 mm white face PVC/polycarbonate face plate or module to suit Euro modular face plates
- 1 Operation: Push on/off and rotate to dim
 - 2 Dimming Type: rotary leading edge
 - 3 Dimming Compatibility and loading:
 - a LED: Yes
 - b GU10: mains voltage Yes
 - c LV Tungsten Halogen: Yes
 - d Compact Fluorescent: Yes
 - 4 Loading restrictions
 - a Max LED Load: 100 W
 - b Min LED Load: 11W
 - c Max tungsten/LV load: 600VA
 - d Min Tungsten/LV load 40W
 - e Max CFL load: 100W
 - 5 Performance
 - a Overload protection: Yes
 - b Minimum level preset: Yes
 - c Soft start: No
 - 6 Standards:
 - a BS EN 55014
 - b BS EN 60669-2-1
 - 7 Electrical details
 - a Input voltage: 230V $\pm$ 10%
 - b Ingress protection: IP20
 - c Frequency: 50Hz $\pm$ 10%
 - d Neutral required: No
 - e Two way switching: Yes
 - f Max terminal capacity: 1.5mm²
 - g Maximum switching capacity: 4A resistive

Y65.2.17 TIME SWITCHES

- A Digital Two channel time switch suitable for DIN rail mounting in consumer units and two or four module enclosures. With following features:
- 1 Voltage rating: 240V 50Hz
 - 2 Current Rating:
 - a Resistive load: 16A
 - b Inductive load: 2.5A
 - c Tungsten lamps: 5A(1000W)
 - d Fluorescent lamps: 1000W
 - 3 Dimensions: 85 x 36 x 68mm
 - 4 Cable Capacity: 2 x 2.5mm² or 4 x 1.5mm²
 - a BS EN 60730-2-7
- B 24 Hour module:
- 1 Wire timer and switch circuits to separate terminals
 - 2 Time switch type - Quartz stabilised solid state 50-hour nickel cadmium battery backup
 - 3 Contacts duty - Inductive
 - 4 Contacts rating - 20A
 - 5 Special programme facilities - 4 No. 'ON' and 'OFF' operations
 - 6 Programme repeat cycle - 24 hour.
- C 7 Day module:
- 1 Wire timer and switch circuits to separate terminals
 - 2 Time switch type - Quartz stabilised solid state 50-hour nickel cadmium battery backup
 - 3 Contacts duty - Inductive
 - 4 Contacts rating - 20A
 - 5 Special programme facilities - 4 No. 'ON' and 'OFF' operations
 - 6 Programme repeat cycle - 7 day.

Y65.2.18 SPECIAL DATA CONNECTORS - GENERAL PURPOSE

- A Provide special sockets where indicated on the drawings that can be incorporated into modular wiring system front plates.
- B D Type: Circuit configurations - Single or twin as indicated:
- 1 Size - 25 pin.
- C HDMI Type HDMI 1.1,1.2,1.3, and 1.4 compatible and HDCP Compliant.
- 1 Output connector: 1 X HDMI Female connector
 - 2 Input Connector: 1 X HDMI Female connector

Y65.2.19 BNC SOCKETS - GENERAL PURPOSE

- A A quick connect/disconnect radio frequency connector used for coaxial cable. It comprises two bayonet lugs on the female connector; mating is fully achieved with a quarter turn of the coupling nut. BNC connectors are used with miniature-to-sub miniature coaxial cable in radio, television, and other radio-frequency electronic equipment, test instruments, and video signals. BNC connectors are made to match the characteristic impedance of cable at either 50 ohms or 75 ohms. They are usually applied for frequencies below 4 GHz and voltages below 500 volts.
- B Circuit configurations - Single or twin as indicated:
- 1 Impedance – 50 and 75 ohm (to suit cables)
 - 2 Mounting – front panel mounted in modular systems

- 3 Insulation: Polyethylene
- 4 Ancillaries: Dust caps for sockets.

Y65.3 PART 3 – EXECUTION

Y65.3.1 EXAMINATION

- A Do not begin installation until substrates have been properly prepared and will not adversely affect the finish of the accessory.
- B If substrate preparation is the responsibility of another installer, notify CA of unsatisfactory preparation before proceeding.
- C Clean surfaces thoroughly prior to installation.
- D Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- E Coordinate requirements for blocking to ensure adequate means for support and installation of equipment.
- F Coordinate requirements for power supply, conduit, disconnect switches and wiring.

Y65.3.2 INSTALLATION GENERAL

- A Comply with the BS7671 (IET Electrical Wiring Regulations) and associated Guidance Notes.
- B Ensure accessories are suitable for the location into which they are to be installed and that they are suitable rated for the systems in which they are to be installed and used.
- C Ensure double pole and triple pole and neutral control switches are in accordance with relevant standards and are matched with other accessories defined in the Specification.
- D Ensure each switch is of the surface or flush pattern as appropriate and install with suitable box and earth fly-lead.
- E If cable outlet plates are required for final connections to equipment, match these to correspond with other accessories.
- F Ensure local lighting switches comply with the manufacture, rating and type as indicated in the specification requirements, equipment schedules or on the drawings.
- G Ensure switches are capable of switching the full rated inductive or resistive load, and where connected to fluorescent loads in excess of 600 watts, use 15-amp rating.
- H Install all switches with boxes of 35mm minimum depth with adjustable lugs to ensure switchplates are true and square where required. Fit boxes flush with wall finish and make any adjustment to depth with extension rings.
- I Ensure all switch boxes are compatible with the wiring system used and are complete with CPC terminal.
- J Where several switches of the same phase are required in the same position, use a multi-ganged switch box to accommodate all switches on a common faceplate.

Where switches are specified for Class 4 installation in situations exposed to weather, or continual dampness, ensure they are of the weatherproof pattern in accordance with the relevant Standard and minimum IP65 rating.
- K Where different phases are present at one switch location, segregate each phase in a separate compartment and cover each compartment by its own internal warning plate suitably engraved. "WARNING 400 VOLTS PRESENT".
- L Mount switches adjacent the closing style of doors where possible.

Y65.3.3 GENERAL INSPECTIONS

- A Carry out the following checks and ensure that findings are satisfactory. Rectify any faults.:
- 1 All accessories comply with the appropriate British Standard
 - 2 Boxes and other enclosures securely fastened
 - 3 Metal boxes and enclosures correctly earthed
 - 4 Flush boxes not projecting above surface of wall
 - 5 No sharp edges which could cause damage to cable insulation
 - 6 Non-sheathed cables not exposed outside box or enclosure
 - 7 Conductors correctly identified
 - 8 Bare protective conductors sleeved green and yellow
 - 9 All terminals tight and contain all strands of stranded conductor
 - 10 Cord grips correctly used to prevent strain on terminals
 - 11 All accessories of adequate current rating
 - 12 Accessories suitable for all conditions likely to be encountered
 - 13 Complies with the requirements for locations containing a bath or shower (where necessary)
- B Lighting controls: Carry out the following checks and ensure that findings are satisfactory. Rectify any faults.
- 1 Light switches comply with appropriate British Standard
 - 2 Switches suitably located
 - 3 Single-pole switches connected in phase conductor only
 - 4 Correct colour-coding of conductors
 - 5 Correct earthing of metal switch plates
 - 6 Switches out of reach of a person using bath or shower
 - 7 Switches for inductive circuits (discharge lamps) de-rated as necessary
 - 8 Switches labelled to indicate purpose where this is not obvious
 - 9 All switches of adequate current rating
 - 10 All controls suitable for their associated luminaire
- C Lighting points: Carry out the following checks and ensure that findings are satisfactory. Rectify any faults.
- 1 All lighting points correctly terminated in suitable accessory or fitting
 - 2 Ceiling roses comply with appropriate British Standard
 - 3 No more than one flexible cord unless designed for multiple pendants
 - 4 Devices provided for supporting fl ex used correctly
 - 5 All switch wires identified
 - 6 Holes in ceiling above ceiling rose made good to prevent spread of fire
 - 7 Ceiling roses not connected to supply exceeding 250 V
 - 8 Flexible cords suitable for the mass suspended
 - 9 Lamp holders comply with appropriate British Standard
 - 10 Luminaire couplers comply with appropriate British Standard
- D Coordination with Other Trades:
- 1 Take steps to ensure that devices and their back boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes
 - 2 Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables
 - 3 Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is trowelled flush with the face of the wall
 - 4 Install wiring devices after all wall preparation, including painting, is complete.
 - 5 Provide intumescent compound when installing devices in fire compartment walls
- E Conductors:

- 1 Do not strip insulation from conductors until just before they are spliced or terminated on devices
- 2 Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire
- 3 The length of free conductors at outlets for devices shall meet provisions of BS 7671+A2.
- 4 Where single cables are being installed, "double over" cables to ensure a good connection.

F Device Installation:

- 1 All wiring devices shall be fixed independently of the system of wiring. All fixings screws or bolts shall be of steel and where the appropriate mounted outside a building the bolts or screws shall be zinc-plated (electro-galvanised) complying with relevant standards and codes of practice
- 2 Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete
- 3 Keep each wiring device in its package or otherwise protected until it is time to connect conductors
- 4 Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment
- 5 Connect devices to branch circuits using pigtails that are not less than 150 mm in length
- 6 When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw
- 7 Use a torque screwdriver when a torque is recommended or required by the manufacturer
- 8 When conductors larger than 2.5mm² are installed on 15A or 20A circuits, splice 2.5mm² pigtails for device connections
- 9 Tighten unused terminal screws on the device
- 10 When mounting into metal boxes, remove the fibre or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

G Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

H Dimmers:

- 1 Install dimmers within terms of their listing
- 2 Install unshared neutral conductors online and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

I Lighting Switches Grid Type assemblies:

- 1 The front plate for the switch shall be provided with an earthing terminal and earth tag connecting the front plate to the metal box. The metal box shall be provided with an earth terminal and shall be connected to the protective conductor of the installation
- 2 Phase barriers must be used in switch boxes where more than one phase is present
- 3 Where metal cover plates are specified as a metal type (not metal-clad) the cover plate shall be fabricated from solid metal. All accessories shall be fitted to adjustable grids over-lapping standard BS 4662 boxes.

J Lighting Switches (Plate type):

- 1 Local lighting plate switches are to be of the all insulated, 20A rated, pattern single pole and shall comply with standards mentioned elsewhere
- 2 Plate switches forming part of a flush installation shall be mounted on metal flush boxes with overlapping plates
- 3 Plate switches forming part of a surface installation shall be mounted on purpose made metal/plastic boxes with the front plates flush with box edges
- 4 All plate switches are to be of the white plastic rocker type either one way, two way, intermediate or multi-gang
- 5 Phase barriers must be used in switch boxes where more than one phase is present

- 6 Where metal cover plates are specified as a metal type (not metal-clad) the cover plate shall be fabricated from solid metal. All accessories shall be fitted to adjustable grids over lapping standard BS 4662 boxes.

K Ceiling Switches:

- 1 Ceiling switches shall either be surface or flush type as indicated on drawings.
- 2 Ceiling switches shall of 20A minimum single pole, one or two way for lighting circuits and double pole for other circuits. Ceiling switches may be indicated as detailed elsewhere
- 3 A minimum length of 1.5m of operating cord shall be provided unless otherwise indicated.
- 4 The colour of operating cord shall be white or natural and shall be terminated in a moulding of rubber or plastic material.

L Toilet Call Switches: Ensure that the installation complies with Building regulations part M and DDM requirements.

- 1 Gripper Pulls:
 - a Lower: 100mm from FFL
 - b Upper: 800-900mm above FFL
- 2 Reset/ sounder: 1200mm above FFL (maximum)
- 3 Overdoor lamp/sounder/PSU: Centrally over the door

M External Lighting Switches:

- 1 All external lighting switches shall be double pole, one way, two-way or multi-gang arrangements and be complete with a gasket forming a splash proof and dustproof enclosure (IP54). The switches shall also comply with standards and regulations mentioned elsewhere
- 2 A suitable drain hole must be provided.

N Telecom, Data and TV Outlets:

- 1 Normally included as part of the specialist IT contractors' scope of works. Where they are to be installed in this project comply with:
 - a ISO/IEC 11801
 - a BS EN 50173
 - b TIA 568
 - c BS EN 41003

Y65.3.4 IDENTIFICATION

- A Comply with V80 "Electrical Identification".

Y65.3.5 FIELD QUALITY CONTROL

- A Perform tests and inspections and prepare test reports as required by:

- 1 Specification Section Y50: Testing and Commissioning of Mechanical and Electrical services
- 2 IET wiring regulations
- 3 Test Instruments: Use instruments that comply with BS7671+A2.

Y65.3.6 EARTHING

- A Ensure metal framework of equipment is bonded to main earth point. Ensure that cable CPC's are connected to earth bar.
- B Provide earth CPC between earth lug on metal box and accessory casing except where accessory is encased in plastic.

Y65.3.7 PROTECTION

- A Ensure there is no physical or electrical damage to accessories when they are removed from their packaging and during installation.
- B Provide masking covers for surface mounted accessories to protect surface from paint.
- C Where accessories are flush mounted install front plate after painting is finished.

Y65.3.8 FIXING

- A Align accessories horizontally and vertically. Where accessories are grouped, mount horizontally in line and parallel to each other and equidistant.
- B Fix cover plates to boxes with brass fixing screws.

Y65.3.9 ACCESSORIES MOUNTING HEIGHTS GENERAL APPLICATIONS

- A Comply with the following installation mounting heights unless indicated otherwise on the drawings:

Accessory	Location	Height (mm)
Lighting switch / dimmer		1200
Emergency Exit Signs		2250
Power Socket Outlets	General	450
Power Socket Outlets	Kitchens	1000
Power Socket Outlets	Above Worktops	200
Shaver socket outlet		1200
Hand dryer fused connection unit		2250
Fused Spurs	General	450
Fused Spurs	Above worktops	200
Fused connection unit (equipment)	Adjacent, to suit equipment layout	
Isolating switch / starter, emergency stop button		1200
Cooker control unit	Above worktop	200
Cooker flex outlet		450
Room thermostat		1200
Telephone/TV outlet		450
Push button / controller		1200
Fire alarm manual call point		1200
Fire alarm sounder		2250
Bell or buzzer		2000
Visible alarm indicator		2000
Loudspeaker control unit		1200
Loudspeaker	To top of unit	2100
Clock		2250

Accessory	Location	Height (mm)
Distribution board	To top of unit	2250 max
Distribution board (domestic)	To top of unit	1000 max

- B Take measurement for position of electrical accessories to the centre line of equipment from either finished floor or worktop. Where specified height coincides with top of tiling, leave a clear gap of 50mm above tiling.
- C Mount equipment below a worktop 100mm below underside of worktop.
- D Provide switches and socket outlets for lighting and other equipment in habitable rooms at appropriate heights between 450mm and 1200mm from finished floor level, in accordance with Building Regulations Approved Document M and BS 8300+A1. All switches and controls shall be a minimum of 350mm from the corner of a room.

Y65.3.10 HOSPITAL AND HELATHCARE PREMISES ACCESSORY INSTALLATION

- A Comply with all relevant HTMs and HBNs and ensure that all accessories are suitable for the clinical risk category into which they are to be installed.
- B For bedhead services comply with Department of Health Technical Design Manual version 5

Y67 TRANSIENT OVER-VOLTAGE SURGE SUPPRESSION DEVICES

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Y67.1 PART 1 - GENERAL

Y67.1.1 RELATED DOCUMENTS

- A Drawings and general provisions of the Contract, including main Contract Preliminaries and section A of this specification.
- B For performance details and physical sizes of plant and equipment refer to section D "Schedules of Equipment"
- C For system descriptions, operating parameters and ambient temperatures refer to section B of this specification and the Schedules of Equipment.
- D Refer also to the following sections:
 - 1 V11 "Low Voltage Connection"
 - 2 V30 "Low Voltage Distribution System"
 - 3 V31 "Low Voltage Switchgear"
 - 4 V33 "Busbar Trunking"
 - 5 V36 "Automatic Power Factor Correction"
 - 6 V37 "Harmonic Filtering Equipment"
 - 7 V80 "Electrical Identification"
 - 8 V81 "Earthing and Bonding Systems"
 - 9 W31 "Data distribution systems"
 - 10 W60 "Lightning Protection"
 - 11 Y41 "Building Monitoring and Management"
 - 12 Y50 Electrical Commissioning
 - 13 Y61 "LV and ELV cables"
 - 14 Y63 "Cable Supports"
 - 15 Y90 "Fixing to buildings"

Y67.1.2 SUMMARY

Omit the requirement for design where this is not required to be undertaken.

- A Design, supply, install, test and commission a complete transient overvoltage protection system in accordance with the drawings and this specification. Ensure risk assessment is carried out and lightning protection systems (LPSs) are provided in accordance with BS EN 62305 (refer to W60 and Section A Preliminaries of this specification).
- B The transient overvoltage protection system specialist shall assess the risk and design an appropriate protection system based on drawings and equipment details.

Y67.1.3 DEFINITIONS

- A EMP – Electromagnetic Pulse
- B ABD -Avalanche Breakdown Diode
- C MOV – Metal Oxide Varistors
- D TSS - Thyristor Surge Suppressors
- E TOPS –Transient overvoltage Protection System
- F CA - Contract Administrator

Y67.1.4 PERFORMANCE REQUIREMENTS

- A All plant and equipment shall achieve specified duty when operating at altitudes between sea level and 150 metres above sea level at ambient temperatures of up to 40°C with RH of 85%.
- B For system operating conditions, temperatures and working pressures refer to section B of this specification.

Y67.1.5 SUBMITTALS

- A Product Data: For each type of product indicated.
- B Shop Drawings: For equipment and mounting accessories:
 - 1 Layout and schematic of the TOPS, along with details of the components to be used in the installation.
- C Qualification Data: For qualified Installer and manufacturer. Include certification by background information confirming projects undertaken in region.
- D Field quality-control reports.
- E Comply with recommendations in BS EN 62305, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the TOPS.

Y67.1.6 QUALITY ASSURANCE

- A Acceptable manufacturers: Firms regularly engaged in manufacture of equipment required for this installation, whose products have been in satisfactory use in similar service for not less than 10 years. Provide equipment produced by a manufacturer listed as an Acceptable Manufacturer in this Section and as approved by the CA.
- B Standards Compliance: Comply with requirements of applicable local codes, BS EN 62305 and regulations pertaining to a TOPS.
- C TOPS: System shall be installed by trades specializing in lightning protection systems.
- D In case of conflict among the referenced standards and codes, the more stringent provision will govern.
- E Ensure the, construction, materials and finishes of all equipment are suitable for the location, climatic and operating conditions to which the installation shall be exposed.
- F Ensure that the whole installation complies with the relevant standards, including the following:
 - 1 BS 951 - Electrical earthing. Clamps for earthing and bonding
 - 2 BS 6004 - Electric cables. PVC insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring
 - 3 BS 7430 - Code of practice for earthing
 - 4 BS 7671+A2 - Requirements for electrical installations. IEE Wiring Regulations. Seventeenth edition.
 - 5 BS EN 1011-4 - Welding. Recommendations for welding of metallic materials. Arc welding of aluminium and aluminium alloys
 - 6 BS EN 12163 - Copper and copper alloys. Rod for general purposes
 - 7 BS EN 13636 - Cathodic protection of buried metallic tanks and related pipework
 - 8 BS EN 50164-1 Lightning protection components (LPC). Requirements for connection components
 - 9 BS EN 50164-2 Lightning protection components (LPC). Requirements for conductors and earth electrodes
 - 10 BS EN 50164-3+A1 Lightning protection components (LPC). Requirements for isolating spark gaps
 - 11 BS EN 50174-1 - Information technology. Cabling installation. Specification and quality assurance
 - 12 BS EN 50174-2 - Information technology. Cabling installation. Installation planning and practices inside buildings
 - 13 BS EN 50174-3 - Information technology. Cabling installation. Installation planning and practices outside buildings

- 14 BS EN 50310 - Application of equipotential bonding and earthing in buildings with information technology equipment.
- 15 BS EN 50539-11 Low-voltage surge protective devices. Surge protective devices for specific application including D.C. Requirements and tests for SPDs in photovoltaic applications
- 16 BS EN 60228 - Conductors of insulated cables
- 17 BS EN 60529 - Specification for degrees of protection provided by enclosures (IP code)
- 18 BS EN 61643-11 Low-voltage surge protective devices. Surge protective devices connected to low-voltage power systems. Requirements and tests
- 19 BS EN 61643-21+A2 Low voltage surge protective devices. Surge protective devices connected to telecommunications and signalling networks. Performance requirements and testing methods
- 20 BS EN 61643-311 Low voltage surge protective devices. Specification for gas discharge tubes (GDT)
- 21 BS EN 61643-321 Low voltage surge protective devices. Specifications for avalanche breakdown diode (ABD)
- 22 BS EN 61643-331 Low voltage surge protective devices. Specification for metal oxide varistors (MOV).
- 23 BS EN 61643-341 Low voltage surge protective devices. Specification for thyristor surge suppressors (TSS)
- 24 BS EN 61663-1 - Lightning protection. Telecommunication lines. Fibre optic installations
- 25 BS EN 61663-2 - Lightning protection. Telecommunication lines. Lines using metallic conductors
- 26 BS EN 62305-1 - Protection against lightning. General requirements
- 27 BS EN 62305-2 - Protection against lightning. Risk management
- 28 BS EN 62305-3 - Protection against lightning. Physical damage to structures and life hazard
- 29 BS EN 62305-4 - Protection against lightning via way of surge protection for Electrical and electronic systems within structures
- 30 TIA/EIA J-STD-607 - Commercial Building Earthing and Bonding Requirements for Telecommunications

G Use materials and installation methods in accordance with BS 7671+A2, BS 7430, BS EN 62305, Electricity Supply Regulations and Local Electricity Supply Authority Requirements as appropriate.

Y67.2 PART 2 – PRODUCTS

Y67.2.1 ACCEPTABLE MANUFACTURERS

A Available Manufacturers: Subject to compliance with requirements provide products by one of the following:

- 1 A N Wallis & Co Ltd
- 2 Furse
- 3 Dehn
- 4 Omega.

Y67.2.2 SURGE PROTECTION SYSTEMS

A Electrical Power Systems - Zone 1:

- 1 Provide Surge Protection to BS EN 62305-4
- 2 Main Incoming Switchboards Lightning Protection Zone 1
- 3 Arresters for power supplies shall be capable of handling both direct lightning impulses 25kA 10/350µs per pole and surge currents 40kA 8/20µs per pole eg Combined arrester Class 1/2
- 4 The arrester must be fully co-ordinated between lightning and surge currents
- 5 The arrester will also limit follow currents of 25kA RMS P.S.S.C. So, fuses/MCBs 32A or greater will not blow/trip
- 6 The arrester must have no leakage current and be able to withstand an insulation test (500V DC) without damage and without being disconnected from the supply
- 7 The arrester must have a maximum let through voltage of less than 1.5kV even in the case of Direct Lightning
- 8 The arrester shall comply with BS EN 62305-4
- 9 The arrester shall be able to withstand multiple direct strikes without damage
- 10 The arrester must have visual indication of status (eg green LED for Ok, red for defect) and shall be equipped with a fault alarm changeover contact to remotely signal if the device fails.

B Electrical Power Systems - Zone 2:

- 1 Provide surge protection to BS EN 62305-4
- 2 Sub distribution boards lightning protection zone 2
- 3 Sub distribution boards more than 10 metres from the main incoming panel shall have additional surge protection as follows: - maximum discharge current 40kA 8/20µs waveform per pole 160kA 8/20µs TP+N systems Class 2
- 4 Protection devices must include varistors
- 5 The arresters must have visual indication of status, (eg green LED for Ok, red for defect) and shall be equipped with a fault alarm changeover contact to remotely signal if the device fails
- 6 The arrester must have thermal dynamic protection which disconnects the device from the supply in case of defect, thus eliminating earth leakage currents
- 7 The arresters shall be of the pluggable type to facilitate easy removal and replacement of defective modules
- 8 The arresters shall have international test approvals, either UL or KEMA.
- 9 The arrester shall comply with international safety requirements for the application of surge protective devices (IEC60364-5-534)
- 10 The arresters must comply with BS EN 62305-4
- 11 To easily distinguish the arrester from circuit breakers and RCDs they must be coloured red.

C Electrical Power Systems - Zone 3:

- 1 Provide surge protection to the latest standard BS EN 62305-4
- 2 Final sub circuits lightning protection zone 3

- 3 Final sub circuits should have protection if the connected equipment is more than 15metres away from the sub-distribution board. It is also recommended to protect fire or burglar alarm panels
- 4 Maximum discharge current 5kA 8/20µs. Class 3
- 5 Protection devices must have indication of failure either visual or acoustic
- 6 The arresters shall comply with BS EN 62305-4
- 7 The arrester shall have international test approvals UL or KEMA.

Y67.2.3 EXTERNAL LIGHTNING PROTECTION

- A For the lightning protection specification refer to section W60

Y67.2.4 DATA/SIGNAL/TELECOMMUNICATION CABLES /SURGE PROTECTION

- A Incoming data links between buildings and systems shall be protected against direct lightning and surge impulses on each core and at both ends.
- B Arresters for data and signals shall be din rail mountable and have pluggable protection modules for easy replacement and be able to be tested on site.
- C Arresters used for protection of data signal lines shall be capable of handling lightning impulse currents of 5kA 10/350µs total per pair or 2.5kA 10/350µs per line.
- D The arresters must also have second stage protection capable of handling surge currents of 20kA 8/20µs per line.
- E Arresters must comply to EN 61644-1 and BS EN 61643 (IEC 61643).
- F Arresters must have removable protection modules to facilitate easy replacement and hot swapping without disruption of the signal and must be able to be tested on site.
- G The whole protection circuit including the decoupling elements must be fitted in the protection module.
- H Screens of cables shall be earthed directly or indirectly via shield earthing even after installation to and from earth loop via the shield.

Y67.3 PART 3 – EXECUTION

Y67.3.1 INSPECTION

- A Examine conditions where transient over-voltage surge suppression system is to be installed.

Y67.3.2 INSTALLATION

- A Install transient over-voltage surge suppression system as indicated, in accordance with manufacturer's written instructions to ensure that installation complies with requirements and serves intended function.
- B Coordinate as necessary to interface installation of the system with the lightning protection system equipment and earthing.
- C Properly guard and protect all work installed in accessible locations.
- D Install all material in a manner to prevent electrolytic action under the presence of moisture.
- E Make all roof, wall or other penetration in a manner to prevent the ingress of water or moisture.
- F Install system so that completed work is unobtrusive and does not detract from the building's appearance.
- G Make installation in a manner to eliminate possibility of displacement and subsequent maintenance.
- H Make all connections mechanically and electrically sound and clean all bonding surfaces just prior to attachment.

Y67.3.3 FIELD QUALITY CONTROL

- A Upon completion of lightning protection system, test system to demonstrate compliance with specifications. When possible, field correct defective equipment, then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected at no additional cost to Owner.
- B Check continuity of entire system.
- C Inspect all connections prior to concealing same and ensure compliance with all applicable sections of this specification.
- D Perform an earth resistance test immediately after driving earthing (ground) rods and furnish test results to CA.

Y67.3.4 INSTALLATION

- A Install TVSS devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B Install TVSS devices for panel boards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- C Comply with manufacturer's written recommendation for conductor and circuit-breaker size for connecting TVSS devices to distribution system. Match circuit-breaker size to conductor size. Coordinate with Drawings.
- D Provide multiple, [30] [60] [100]-A circuit breaker as a dedicated disconnecting means for TVSS unless otherwise indicated.

Y67.3.5 FIELD QUALITY CONTROL

Retain one of first two paragraphs below to identify who shall perform tests and inspections. If retaining second option in first paragraph, retain "Field quality-control reports" Paragraph in "Submittals" Article.

- A Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B Tests and Inspections:
 - 1 Perform visual and mechanical inspection and electrical tests on each device. Certify compliance with test parameters
 - 2 After installing TVSS devices but before electrical circuitry has been energized, test for compliance with requirements
 - 3 Complete startup checks according to manufacturer's written instructions.
- C TVSS device will be considered defective if it does not pass tests and inspections.
- D Prepare test and inspection reports.

Y67.3.6 STARTUP SERVICE

- A Do not energize or connect [service entrance equipment] [panel boards] [control terminals] [data terminals] to their sources until TVSS devices are installed and connected.
- B Do not perform insulation resistance tests of the distribution wiring equipment with the TVSS installed. Disconnect before conducting insulation resistance tests and reconnect immediately after the testing is over.

Y67.3.7 DEMONSTRATION

- A [Engage a factory-authorized service representative to train] [Train] Owner's maintenance personnel to maintain TVSS devices.
- B Install equipment under direct supervision of the equipment manufacturer's factory representative.
- C Fully test the complete lightning protection system in the presence of the CA or their authorised representative to demonstrate continuity of all conductors. Submit a written test report in format approved by CA.

Y67.3.8 CORROSION PROTECTION

- A Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

Y90 FIXING TO BUILDING FABRIC

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Y90.3.17	FIXING TO STRUCTURAL STEELWORK AND CONCRETE STRUCTURES
Y90.3.18	FIRE STOPPING MATERIAL INSTALLATION

Y90.1 PART 1 – GENERAL

- A This section relates to the fixing into the structure for building services items.
- B Details of fire stopping (fire stop boards, putties and mortars) are also included here for use where services pass through fire or acoustically rated walls and floor constructions. See also sections
- 1 Electrical services: Y60 & Y61
 - 2 Ductwork: U80
 - 3 Pipework: Y10

Y90.1.2 RELATED DOCUMENTS

- A For drawings and general provisions of the contract refer to main contract preliminaries and section A of this specification.
- B For performance details and physical sizes of plant and equipment requiring fixing refer to section D "Schedules of Equipment".
- C For system descriptions refer to the drawings and section B of this specification.

Y90.1.3 SUMMARY

- A This section covers fixing to:
- 1 Reinforced Concrete
 - 2 Brickwork
 - 3 Timber rails
 - 4 Hollow Rails
 - 5 Metalwork
 - 6 Structural Steelwork.
- B This section includes the following types of fixings:
- 1 Plugs
 - 2 Screw fixings
 - 3 Shot fired fixings
 - 4 Self-adhesive fixings
 - 5 Proprietary Cannel Inserts
 - 6 Drilling
 - 7 Proprietary fixings.
- C Fire stopping:
- 1 Ablative mineral/rock wool batts
 - 2 Intumescent putty
 - 3 Intumescent mortar

Y90.1.4 DEFINITIONS

- A Anchor: Fixing element of fastener cast into concrete, or post installed into a concrete used to transmit applied loads.

Y90.1.5 PERFORMANCE REQUIREMENTS

- A Advise the structural engineer for the project of the loadings of plant and equipment and agree the suitability of the proposed fixing methods.

- B The fixing method should be strong enough to resist the loads being applied to it and be suitable for the anticipated lifetime of the system being supported.
- C Design fixings to prevent failure of fixings that could:
 - 1 Result in collapse or partial collapse of the services installations
 - 2 Cause risk to human life
 - 3 Lead to significant economic loss.
- D Allow for all operating conditions of the services installations. Make allowances for wind and snow loads on externally located plant and equipment.
- E Apply an appropriate safety factor which caters for installation inaccuracies.
- F Allow for expansion where additional services are likely to be installed in the future. This is particularly important for cable trays and containment systems which are provided for following on trades.
- G Fixings should not reduce the fire resistance of the structure.

Y90.1.6 SUBMITTALS

- A Refer to Section A of this specification.
- B Provide details for approval of all proposed fixing methods for each type of substrate. Include the following:
 - 1 Loading details
 - 2 Dimensions
 - 3 Material specifications.

Y90.1.7 QUALITY ASSURANCE

- A Ensure that the design, construction, materials and finishes of all equipment are suitable for the location, climatic and operating conditions to which the installation shall be exposed.
- B Ensure that the whole installation complies with the relevant standards, including the following:
 - 1 BS EN 1991-1-1: Eurocode 1. Actions on structures. General actions. Densities, self-weight, imposed loads for buildings
 - 2 DD CEN/TS1992-4-1: Design of fastenings for use in concrete. General
 - 3 DD CEN/TS 1992-4-2: Design of fastenings for use in concrete. Headed fasteners
 - 4 BS 1210 - Specification for wood screws
 - 5 BS 5080-1 – Structural fixings in concrete and masonry. Method of Test for Tensile loading.
 - 6 BS 5080-2 – Structural fixings in concrete and masonry. Method for determination of resistance to loading in shear.

Y90.1.8 CO-ORDINATION

- A Where fixings are visible in finished areas ensure that the fixing methods are approved by the CA.
- B Co-ordinate the casting in of supports with the contractor responsible for the concrete works. Provide all necessary setting out information and details to assist the contractor.

Y90.2 PART 2 - PRODUCTS

Y90.2.1 GENERAL

- A Mark-out, set-out and firmly fix all equipment, components and necessary brackets and supports.
- B Manufacturer's Drawings: Use manufacturer's drawings and templates for purposes of marking and setting out.
- C Fixings: Ensure structure and fixings are suitable for items to be fixed.
- D Loading Details: Provide loading details for all fixing types.
- E Size of Fixing: Use largest size of bolt, screw or other fixing permitted by diameter of hole in item to be fixed.
- F Greasing of Fixings: Ensure all bolts, screws or other fixings used are greased or lubricated in accordance with manufacturer's instructions.

Y90.2.2 FASTENERS GENERALLY

- A Materials: To have:
 - 1 Bimetallic corrosion resistance appropriate to items being fixed
 - 2 Atmospheric corrosion resistance appropriate to fixing location.
- B Appearance: Submit samples on request.

Y90.2.3 MASONRY FIXINGS

- A Light duty: Use Plugs and screws.
- B Heavy duty: Use Expansion anchors or chemical anchors.

Y90.2.4 PLUGS

- A Type: Proprietary types to suit substrate, loads to be supported and conditions expected in use.
- B Use plugs of suitable size and length for fixings. Use plastic, fibrous or soft metal non-deteriorating plugs to suit application. Do not use wood plugs.
- C Ensure that when screw is in place, threaded length is in plug. Ensure plugs used for screw fixing are set-in to correct depth prior to final tightening.

Y90.2.5 ANCHORS

- A Types:
 - 1 Expansion: For use in substrate strong enough to resist forces generated by expansion of anchor.
 - 2 Adhesive or chemical:
 - a For use in substrate where expansion of anchor would fracture substrate
 - b For use in irregular substrate where expansion anchors cannot transfer load on anchor.
 - 3 Cavity: For use where the anchor is retained by toggles of the plug locking onto the inside face of the cavity.
- B Test for tensile loading in accordance with BS 5080-1.

Y90.2.6 SCREWS

- A Use screws to BS 1210. Generally, use sherardized steel wood screws for fixing to concrete, brickwork or blockwork.
- B In damp or exposed situations use greased brass wood screws.
- C Wood Screws:
- 1 Wood screws: Traditional pattern:
 - a Standard: To BS 1210.
 - 2 Wood screws. Parallel pattern: fully threaded shank or twin thread types
 - 3 Washers and screw cups: Where required are to be of same material as screw.
- D Miscellaneous Screws:
- 1 Type: To suit the fixing requirement of the components and substrate:
 - a Pattern: Self-tapping, metallic drive screws, or power-driven screws.
 - 2 Washers and screw cups: Where required to be of same material as screw.

Y90.2.7 CAST-IN FIXINGS

- A Where cast-in fixings are permitted, mark out and set fixings in accordance with manufacturer's instructions.

Y90.2.8 SHOT FIRED FIXINGS

- A Obtain approval prior to using shot fired type fixings.

Y90.2.9 SELF-ADHESIVE FIXINGS

- A Obtain approval prior to using self-adhesive type fixings.

Y90.2.10 PROPRIETARY CHANNEL INSERTS

- A Provide proprietary channel inserts for casting in where indicated.

Y90.2.11 DRILLING

- A Drill holes squarely. Use drills of requisite size and depth, and appropriate to fabric. Do not flame-cut holes in metal work.

Y90.2.12 PROPRIETARY FIXINGS

- A Comply with manufacturer's instructions for all fixings.

Y90.2.13 FIRE STOP BOARDS/ABLATIVE COATED BATTS

- A Application: Use for services installations where openings are formed to allow services to pass through and the batts provide an airtight, acoustic and fire rated infill panel around the services.
- B Description: The ablative coated board/batt comprises a rigid mineral or rock wool board used to seal large services openings in solid walls or floors and partition walls. The ablative intumescent coating absorbs the energy from a fire to provide insulation as it chars.
- 1 Testing: Products to be fire tested and acoustically tested
 - a Fire tests:
 - BS 476 pt 20
 - BS EN 1366-3.

- b Acoustic Tests:
 - BS EN ISO 140-10: 1992
 - ISO 140-9 & BS EN ISO 10848 Dn, f, w,
- 2 Single batt:
 - a Max opening size: 2400mm high x 5000mm wide x 50mm thick
 - b Fire properties up to:
 - Integrity: 2 hours
 - Insulation: 90 minutes
 - Acoustic Insulation: $R_w = 39\text{dB}$
- 3 Double batt:
 - a Max opening size: 2400mm high x 5000mm wide x 50mm thick
 - b Fire properties up to:
 - Integrity: 3 hours
 - Insulation: 120 minutes
 - Acoustic Insulation: $R_w = 52\text{dB}$
- 4 Dry lined plasterboard wall openings require a framing of the opening.

Y90.2.14 FIRE STOP INTUMESCENT ACOUSTIC PUTTY PADS

- A Application: Use for the sealing of services penetrations and for increasing the fire resistance of wall mounted accessories in dry lined constructions. Use in fire resisting or acoustically rated partitions.
- B Description: A mouldable, non- setting, self-adhesive fire and smoke resistant putty in pad form. Physical properties:
 - 1 Chemical basis: synthetic rubber
 - 2 Temperature range: 5-35°C
 - 3 Reaction temperature: 140°C
 - 4 Density: 1.6kg/m³
 - 5 R_w : up to 71 dB
- C Testing: Products to be fire tested and acoustically tested
 - 1 Fire tests:
 - a BS 476 pt 20
 - b BS EN 1364-1.
 - 2 Acoustic Tests:
 - a BS EN ISO 140-3
- D Fire properties up to:
 - 1 Integrity: 2 hours
 - 2 Insulation: 120 minutes
 - 3 Acoustic Insulation: $R_w = 71\text{dB}$

Y90.2.15 FIRE STOP MORTARS

- A Application: Use for the sealing of services penetrations and for increasing the fire resistance of fire stop boards. Formers or shutters are required in larger openings. For use with cables, cable trays and baskets, building in of ductwork fire dampers and metal pipes.
- B Description: A fire resistant, gypsum-based mortar with thermal insulating properties used to seal medium sized penetrations. Use in walls and floors, in concrete, porous concrete and masonry constructions. Physical properties:
 - 1 Chemical basis: Concrete mortar with perlite
 - 2 Temperature range: 5-40C
 - 3 Reaction temperature: 140°C

4 Rw: up to 59 dB

C Testing: Products to be fire tested

- 1 BS 476: Part 20,
- 2 BS EN 1366-3.
- 3 Fire resistance 1 - 4 hours

Y90.2.16 INTUMESCENT SEALANT

A Application: Intumescent Sealant may be used to form penetration seals around cables, pipes and conduits in fire rated walls and floors

B Description: A high expansion pressure exerting intumescent firestop mastic. Use in walls and floors, in concrete, stud partitions, porous concrete and masonry constructions. Physical properties:

- 1 Chemical basis: Water based intumescent acrylate
- 2 Temperature range: 5-40C
- 3 Reaction temperature: 140°C
- 4 Rw: up to 59 dB
- 5 Density: 1.5g/cm³

C Testing: Products to be fire tested

- 1 BS 476: Part 20,
- 2 BS EN 1366-3.
- 3 Fire Insulation: 4 hours
- 4 Fire Integrity: 2-4 hours depending upon application

Y90.3 PART 3 - EXECUTION

Y90.3.1 FIXING GENERALLY

- A Integrity of supported components: Select types, sizes, quantities and spacing of fixings, fasteners and packings to retain supported components without distortion or loss of support.
- B Components, substrates, fixings and fasteners of dissimilar metals: Isolate with washers/ sleeves to avoid bimetallic corrosion.
- C Appearance: Fixings to be in straight lines at regular centres.

Y90.3.2 FIXING THROUGH FINISHES

- A Penetration of fasteners and plugs into substrate: To achieve a secure fixing.

Y90.3.3 FIXING PACKINGS

- A Function: To take up tolerances and prevent distortion of materials and components.
- B Limits: Do not use packings beyond thicknesses recommended by fixings and fasteners manufacturer.
- C Locations: Not within zones to be filled with sealant.

Y90.3.4 FIXING CRAMPS

- A Cramp positions: Maximum 150 mm from each end of frame sections and at 600 mm maximum centres.
- B Fasteners: Fix cramps to frames with screws of same material as cramps.
- C Fixings in masonry work: Fully bed in mortar.

Y90.3.5 SCREW FIXING

- A Finished level of countersunk screw heads.
- B Exposed: Flush with timber surface.
- C Concealed (holes filled or stopped): Sink minimum 2 mm below surface.

Y90.3.6 PELLETED COUNTERSUNK SCREW FIXING

- A Finished level of countersunk screw heads: Minimum 6 mm below timber surface.
- B Pellets: Cut from matching timber, match grain and glue into full depth of hole.
- C Finished level of pellets: Flush with surface.

Y90.3.7 PLUGGED COUNTERSUNK SCREW FIXING

- A Finished level of countersunk screw heads: Minimum 6 mm below timber surface.
- B Plugs: Glue into full depth of hole.
- C Finished level of plugs: Projecting above surface.

Y90.3.8 USING POWDER ACTUATED FIXING SYSTEMS

- A Powder actuated fixing tools: To BS 4078-2 and Kitemark certified.

B Operatives: Trained and certified as competent by tool manufacturer.

Y90.3.9 APPLYING ADHESIVES

A Surfaces: Clean. Adjust regularity and texture to suit bonding and gap filling characteristics of adhesive.

B Support and clamping during setting: Provide as necessary. Do not mark surfaces of or distort components being fixed.

Finished adhesive joints: Fully bonded. Free of surplus adhesive.

Y90.3.10 FIXING TO REINFORCED CONCRETE

A Take precautions to avoid fixing through reinforcement.

Y90.3.11 FIXING TO BRICKWORK

A Do not fix to unsound material or mortar between brickwork courses.

Y90.3.12 FIXING TO TIMBER RAILS

A Fix equipment, brackets and supports by drilling hole through timber rail and fixing with bolt, back plate, washer and loose nut.

Y90.3.13 FIXING TO HOLLOW STUD / TILE / BLOCK WALLS

A Fix equipment, brackets and supports where there is access at rear of wall, by drilling hole through wall and fixing with bolt, back-plate, washer and loose nut.

B Fix equipment, brackets and supports where there is no access at rear of wall, drill hole and use screw anchor type fixing or gravity type toggle fixing.

Y90.3.14 FIXING TO CONCRETE, BRICKWORK OR BLOCKWORK

A Fix equipment, brackets and supports using wood screws in plugs.

B Drill holes and fix using steel bolts of grouted bolt type or expanding bolt type fixing.

Y90.3.15 FIXING TO METALWORK

A Fix equipment, brackets and supports by drilling holes and fixing using set screws or bolts complete with washers, shake proof washers and loose nuts.

Y90.3.16 NON-PENETRATIVE SUPPORT SYSTEMS FOR ROOF MOUNTED PLANT

A Provide manufacturer's information on recommended support systems. Obtain the necessary approvals to use non-penetrative support systems as follows:

- 1 Ensure that the roof surface is compatible with non-penetrative supports
- 2 Ensure that approval is given by the Structural Engineer, the Architect and the CA
- 3 Ensure that manufacturer's recommendations are complied with concerning mounting positions, roof loading parameters, wind loadings, point loads, and pressures
- 4 Ensure only manufacturer's specified components such as support legs and support frames are used
- 5 Ensure that future maintenance access to roof finish is provided under support system.

Y90.3.17 FIXING TO STRUCTURAL STEELWORK AND CONCRETE STRUCTURES

- A Provide manufacturer's information on recommended fixing. Obtain approval for any fixing to structure steel work and concrete structures.
- B Generally, use proprietary fixings to structural steelwork and concrete structures.
- C Obtain approval to cut holes in structural steelwork or concrete structures or weld to structural steelwork.

Y90.3.18 FIRE STOPPING MATERIAL INSTALLATION

- A Always comply with manufacturer's instructions/details. Refer also to standard details. Ensure products used will provide the required fire resistance of the intervening wall or floor.
- B Installing Fire stop Boards/Batts:
 - 1 Fit tight into void between the floor or wall and the penetrating services. All cut edges to be coated with appropriate mastic before jointing
 - 2 Supporting of batts and services: refer to manufacturer's instruction for suitable support frame where required and fixing details for support of batt and services where required (eg dampers)
 - 3 Face of batts: Flush with surface of wall, floor or soffit
 - 4 Joints: Seal and close butt joints with appropriate fire resisting sealant, kept to minimum
 - 5 Gaps between services and bulkhead: For non-combustible services seal with appropriate fire resisting sealant. Combustible services to be sealed with appropriate Intumescent sealing product as per manufacturer's recommendations and supporting test evidence
- C Intumescent Putty:
 - 1 Where intended to be used seek confirmation from the main contractor that the use of fire-resistant putty when installed in accordance with the manufacturer's instruction will provide sufficient fire and acoustic separation in accordance with the specification for the dry lining. If not approved agree an alternative detail.
 - 2 Openings to be fully framed by the dry lining contractor
 - 3 Apply or mould the putty pad to the rear of all wall mounted accessories. The pad may be installed in one piece, or in several sections, providing all joints are moulded together.
 - 4 Take care to seal any gaps between the back box and the plasterboard and around the cable entry
 - 5 Do not use in areas exposed to water.
- D Fire Rated Mortar
 - 1 Installers: use trained and 3rd party accredited installers as recommended by manufacturer of mortar
 - 2 Constraints:
 - a Minimum building component thickness:
 - Wall: 150mm
 - Floor: 100mm
 - b Maximum opening size:
 - Walls: 12500x200mm high
 - Floors: 600x600mm
 - c Electrical services: Minimum distances:
 - From cable tray to side of opening: 0mm
 - Between cable trays: 40mm
 - d Maximum cable loading: 60% (of opening size)
 - 3 Sequence: Install mortar after services have been permanently installed, allowing access to remote corners. Co-ordinate installation with mechanical and electrical service installers. Fire dampers to be fitted in line with floor or wall, with builders' frames and to be held rigidly in position by adequate supporting framework
 - 4 Base material suitability: Remove loose builders' material, degrease and ensure that opening bounded by suitable structural elements

- 5 Shuttering: Install suitable shuttering panels to opening, providing adequate support for wet weight of mortar
- 6 Support framework: Install support framework as recommended by manufacturer and in accordance with said manufacturer's recommendations where required
- 7 Temperature: Do not apply mortar when it could be damaged by frost
- 8 Powder to water ratio: To manufacturer's recommendations. Contractor to submit proposals and manufacturer's written instructions
- 9 Mortar Cure: Do not disturb mortar before final set has taken place
- 10 Load bearing: Only permit foot traffic after curing has taken place and only when manufacturer's written evidence has been provided to prove suitability
- 11 Shuttering: Remove combustible shuttering after mortar has cured

E Pressure exerting mastic Sealant:

- 1 Installers: use trained and 3rd party accredited installers as recommended by manufacturer of sealant
- 2 Sequence: Install sealant after services have been permanently installed, allowing access to remote corners. Co-ordinate installation with mechanical and electrical service installers.
- 3 Base material suitability: Remove loose builders' material, degrease and ensure that opening bounded by suitable structural elements
- 4 Temperature: Do not apply sealant outside of stated working conditions
- 5 When used in 50mm flexible batts ensure sealant penetrates the full depth
- 6 Constraints:
 - a Maximum opening size:
 - Walls: 160mm diameter, 300cm²
 - Floors: 160mm diameter, 300cm²
 - b Min space around service
 - Walls: 20mm
 - Floors: 10mm
 - c Minimum depth of sealant:
 - Cables: 20mm
 - Pipes: 40mm
 - d Electrical services: Minimum distances:
 - From cable to side of opening: 10mm
 - Between openings: 200mm
 - e Maximum cable loading: 60% (of opening size)