

NML MLK Temporary Toilets

MEP Tender Package

NML-BHE-XX-XX-SP-J-0001

0047122

15 December 2020

Revision P01

Revision	Description	Issued by	Date	Checked
P01	Tender Package for Comment	RS	15/12/2020	RS

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author

Ross Stevenson

date

approved

signature

date

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1 Introduction

The below document has been prepared for the NML in relation to the Events Welfare Facilities MLK Building Temporary Toilet works in Liverpool, United Kingdom.

The Design Team is comprised of –

- National Museums Liverpool - Client
- Feilden Clegg Bradley Studios LLP – Architect
- BuroHappold – MEP Consultants.

The documents shall be reviewed in conjunction with the Architect’s package of works.

2 Description of Works

2.1 General Works

The works will create a temporary toilets installation and baby change facilities for use within the MLK building. This will generally be achieved by the modification of existing office space at ground floor level and the installation of toilet facilities.

2.2 MEP Works

MEP works will generally be constrained to -

- Water services
- Drainage
- Ventilation
- Small power
- Lighting
- Smoke detection and fire alarms
- Disabled alarm

The Main Contractor will be responsible for installing the proposed scheme in coordination with the existing service. General alteration to the proposed scheme is expected due to the nature of the existing building and should be accounted for within the Main Contractor's proposals.

The Main Contractor shall undertake suitable survey work of the existing services, architecture and structure within the area of the proposed works and make suitable allowances and alterations to the proposals to achieve the necessary proposed scheme. Any modifications should be highlighted to the Design Team & Client prior to being undertaken.

The below sections describe the proposed installation, refer to the materials and workmanship section for further installation requirements.

2.3 Water Services

The contractor shall investigate the existing water services installation within the area of the proposed works.

A cold water connection shall be taken from the adjacent kitchen space (assumed to be a 22mm boosted cold water supply). The cold water supply shall then be extended to the baby change and the new toilet installations to supply -

- Toilets – 15mm connection
- Wash hand basin – 15mm connection
- Point of use water heater – 15mm connection

The point of use water heater will then provide a 15mm hot water connection to the wash hand basins. It is proposed to locate the water heater within the IPS below the wash hand basin. Suitable isolating, pressure reducing and check valves shall be provided as required to the point of use water heaters. An isolating valve shall be provided to each toilet cubicle installation to allow complete isolation of the water services for maintenance. Valve shall be located adjacent to access panels or behind IPSs. Drain cocks shall be provided at system low points to allow drain down.

2.4 Drainage

The contractor shall investigate the existing drainage services installation within the area of the proposed works and on the floor below.

The wash hand basin within the baby change shall connect into drainage within the adjacent kitchen space, which shall be extended accordingly. In the event the existing drainage levels are insufficient the wash hnd basins drainage connection shall drop to the floor below and connect into the new drainage installation.

The new toilet installation will require a new drainage stack be installed to the below floor. The stack shall terminate at high level above the toilet pod to an air admittance valve. The stack shall continue through the floor to high level below, across to the adjacent toilet space and into an existing stack. The route shall be investigated on site by the contractor. Rodding eyes shall be provided above floor and at changes of direction.

Should levels be insufficient for connection a commercial grade macerator and lifting station may be employed to connect the new drainage system to the existing drainage.

The new toilets shall connect into a 110mm header drain before connecting into the stack. Wash hand basins shall connect into a 50mm header drain before connecting into the toilet header drain. Fitting connections shall be -

- Toilets – 110mm
- Wash hand basins – 32mm

All pipework shall be laid to a fall in the direction of flow.

2.5 Ventilation

The contractor shall investigate any existing ventilation services within the area. The contractor shall also site measure the existing window to be used for exhaust discharge, and compare this against the proposed louvre, selecting a suitable and approved alternative if required.

A new extract systems shall be provided to the toilets and baby change. Ceiling extract grilles shall be provided to the toilet and baby changes to provide -

- Baby change – 100l/s
- Accessible toilet – 50l/s
- Cubicles– 30l/s each

Extract valve grilles shall be used to balance the system, with volume control dampers on main branches.

The toilet extract fan shall be located within the void above the toilet pod. The contractor shall suspend the fan from the ceiling or provide a framing from the toilet pod construction. Antivibration mounts shall be provided.

The fan shall be provided with a speed controller for commissioning and a 7-day timer.

2.6 Small power

The contractor shall investigate the existing power installation within the area of the proposed works, and identify the source of supply. The contractor shall identify a suitable distribution board to feed the new power supplies.

Power supplies shall be provided to -

- Cleaner sockets
- Lighting
- Disabled alarm
- Door actuators and controllers
- Fire alarm system
- POU water heaters
- Hand dryers

- Extract fan

The works shall include the modification of an existing push button door controller to the stairwell. An additional new actuated door system shall be supplied on the main door into the toilet facilities. The contractor shall provide a suitable actuator for use with the specified door, and wall mounted push button door controllers on each side of the door.

2.7 Lighting

Lighting shall be provided to the space for general visibility and use in emergency situations.

A new lit toilet signage shall be supplied within the forum space.

Each space shall be fitted with a downlight fitted with an integral battery for use in emergency situations. The contractor shall provide a system to allow for the testing the emergency lighting.

As the installation is temporary no intelligent control system is proposed. It is proposed to use presence detection to control the lighting based upon occupancy, with manual switches for deactivation of the general lighting.

Space lighting shall generally consist of recessed downlights in the toilet cubicles and baby change. Within the main circulation space pendant style lights shall be provided, with linear strip lighting provided recessed around the toilet pod.

Refer to the architect's package for setting out.

2.8 Smoke Detection and Fire Alarm

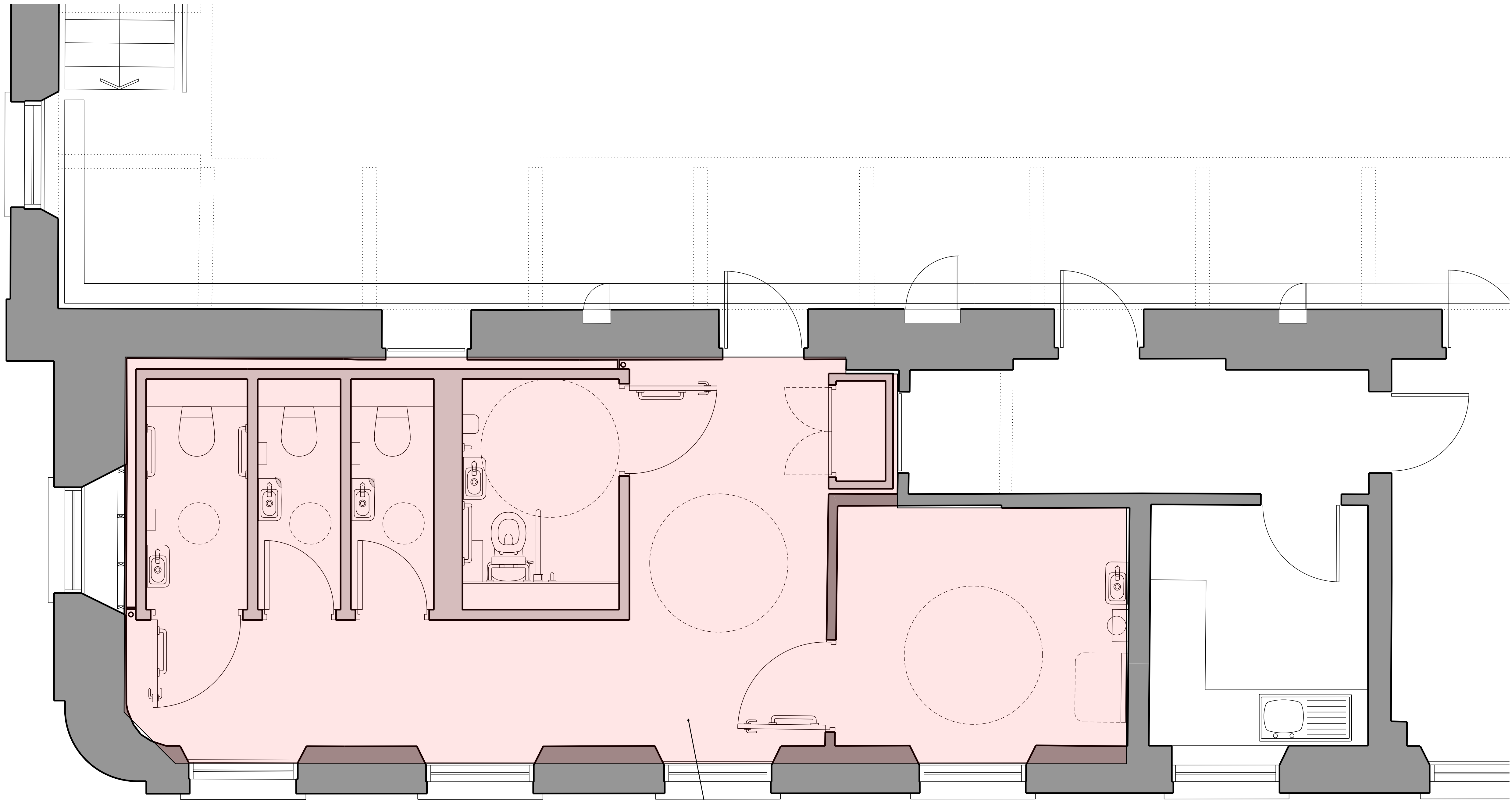
The contractor shall employ a specialist design contractor to review the current installation and design a suitable and compatible installation for the temporary toilet spaces. This shall be provided to the Design Team/Client for review prior to installation.

2.9 Disabled Alarm

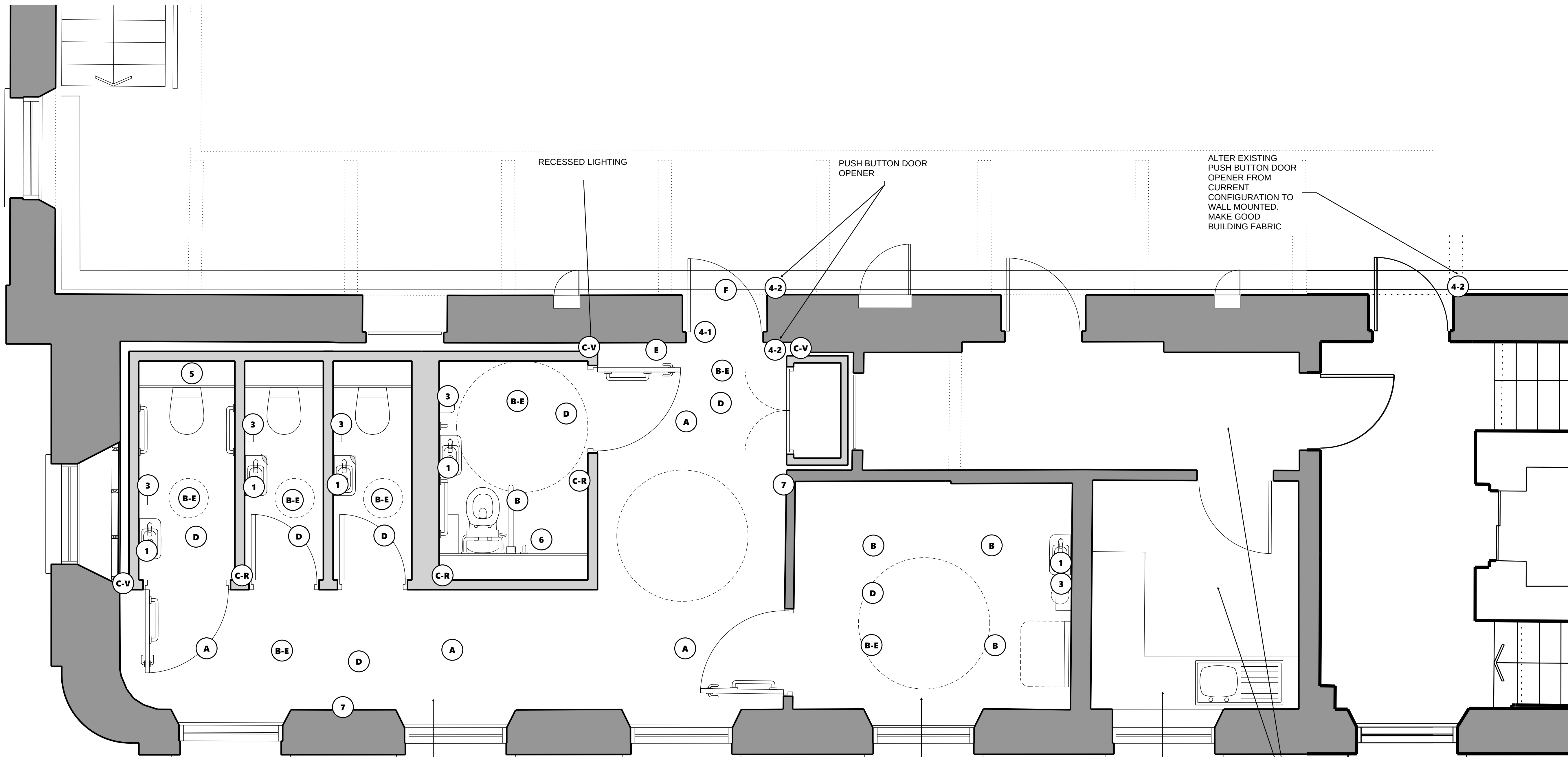
A new disable alarm shall be provided to the accessible toilet space. The system shall comprise of

- Ceiling mounted pull switch
- Local reset button with LED and sounder
- Overdoor triangular lens with integral sounder
- Control panel, located at a front of house area for remote notification (location TBC by client)

The installation shall comply with BS8300. The installation shall be provided with suitable power supplies and mounting boxes.



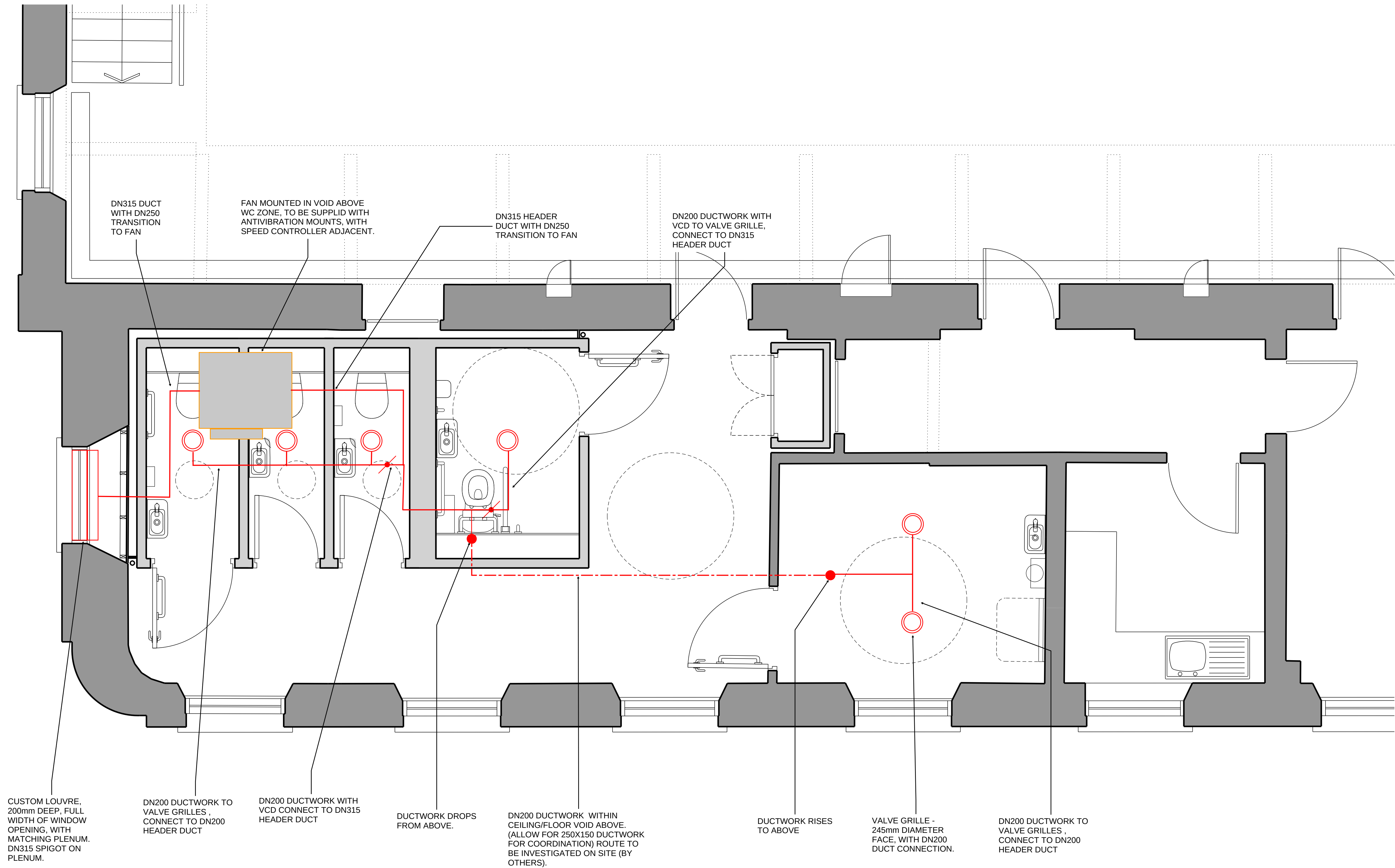
PROVISION OF FIRE ALARMS AND SMOKE DETECTION TO BE UNDERTAKEN AS PART OF SPECIALIST CONTRACTOR DESIGN PACKAGE. NEW DETECTION AND ALARMS TO BE LINKED WITH EXISTING SYSTEM.

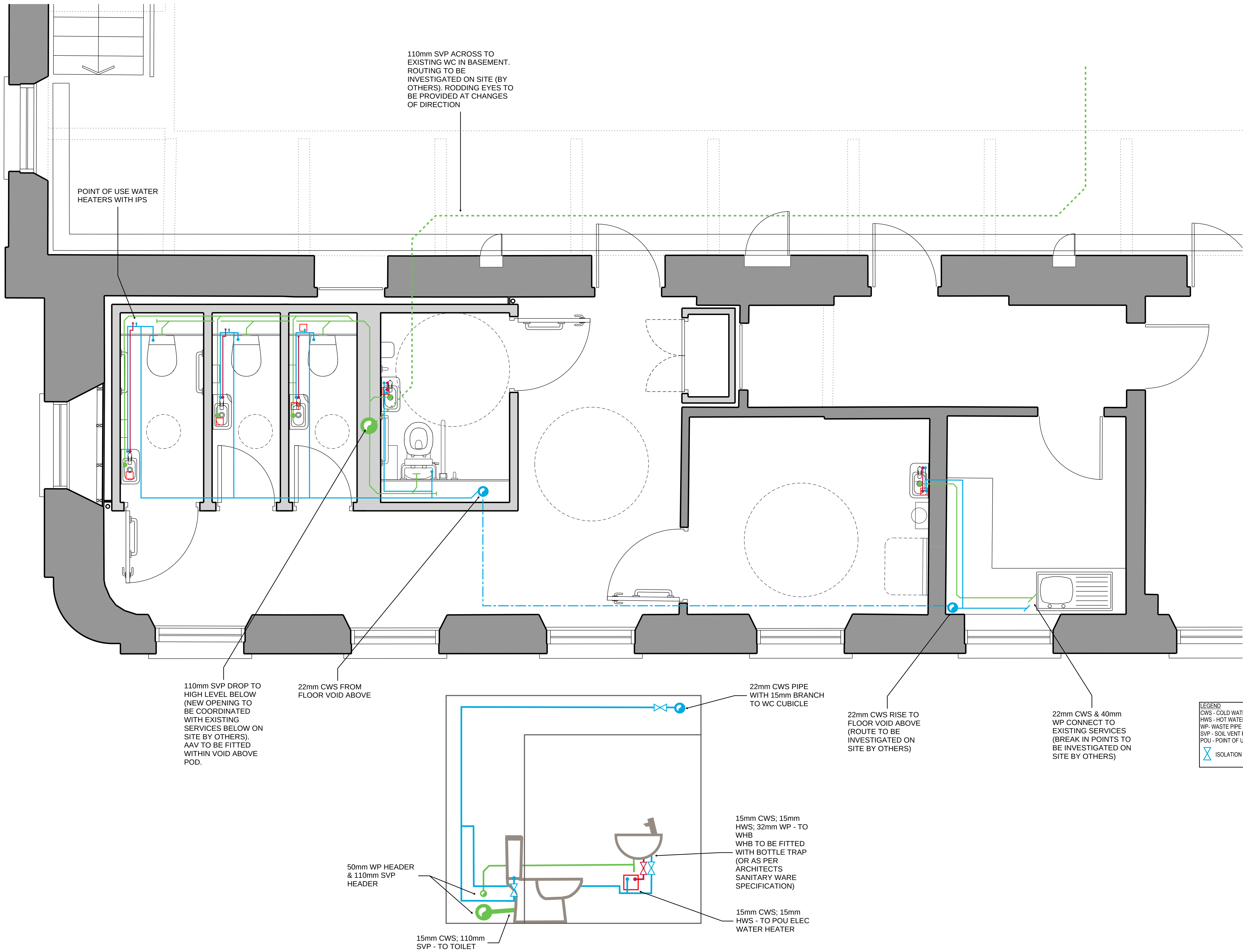


- LEGEND POWER
- 1. FUSED POWER SUPPLY FOR POU WATER HEATERS
 - 2. NO LONGER IN USE
 - 3. FUSED POWER SUPPLY FOR HAND DRYERS
 - 4-1. FUSED POWER SUPPLY FOR DOOR OPENER
 - 4-2. DOOR OPENER PUSH BUTTON
 - 5. FUSED POWER SUPPLY FOR FAN
 - 6. DISABLED ALARM SYSTEM
 - 7. CLEANERS SOCKET

- LEGEND LIGHTING
- A. SUSPENDED LED CEILING FITTING
 - B. LED SPOTLIGHT
 - B-E. EMERGENCY LED SPOTLIGHT WITH INTEGRAL BATTERY
 - C-V. VERTICAL LINEAR LED FITTING
 - C-R. RECESSED LINEAR LED FITTING
 - D. PIR
 - E. LIGHT SWITCH
 - F. ENTRY LIGHT

- GENERAL NOTES
- 1. All works to comply to the requirements of BS7671 – IET Wiring Regulations.
 - 2. Earthing and bonding to be provided in accordance with BS7671. All circuits to have separate dedicated CPC same size as phase conductor.
 - 3. All electrical circuits to be wired in LSF single core cable within metallic conduit and / or trunking.
 - 4. Existing cable trunking can be used if required and on suitable routes subject to ensuring the trunking is not over capacity.
 - 5. Each fused connection unit to be on dedicated circuit from existing local distribution board. Circuit details 20A MCB 3 x 1c 2.5mm² LSF single core cable.
 - 6. Flexible cable from connection unit to equipment to be same size as supply cable.
 - 7. All lighting devices to be wired on single circuit from existing local distribution board. Circuit details 10A MCB 3 x 1c 2.5mm² LSF single core cable.
 - 8. All lighting PIR's to be presence detectors with adjustable off time delay of 0-20mins
 - 9. All circuits to be tested in accordance with BS7671 and record information such as distribution board charts to be updated as required.
 - 10. Disabled alarm system to consist of pull cord with reassurance light when activated adjacent to toilet with cord down to floor, reset unit adjacent to door inside the room and visual and audible alarm external to the room above the door.
 - 11. Refer to architectural specification for light fitting details.
 - 12. Contractor to validate light fitting arrangement by undertaking lighting calculations ensure the lighting level does not exceed 200lux.
 - 13. Separate self-contained emergency lighting to be provided with 3 hour duration and provide lighting levels to the relevant BS standards with a minimum of 1lux at floor level in all areas. Contractor to undertake calculations and validate proposed layout.
 - 14. Fire alarm devices to be wired by extending the existing system in accordance with the requirements of BS 5839, contractor to engage the services of the present system maintainer or suitably qualified specialist contractor to undertake the works including completion of the design, system calculations, installation and testing and commissioning. All current record information to be fully updated to reflect the works.
 - 15. Refer to architectural package of setting out information.
 - 16. Contractor to review existing electrical installation and select suitable existing distribution board to supply all electrical outlets from.





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JOB TITLE: NML EVENTS WELFARE FACILITIES MLK BUILDING - TEMPORARY TOILETS
SKETCH TITLE: PUBLIC HEALTH PROPOSALS

JOB NUMBER: 0047122
SKETCH NUMBER: MLK-WEL-004

DATE: 15/12/2020
INITIALS: RS

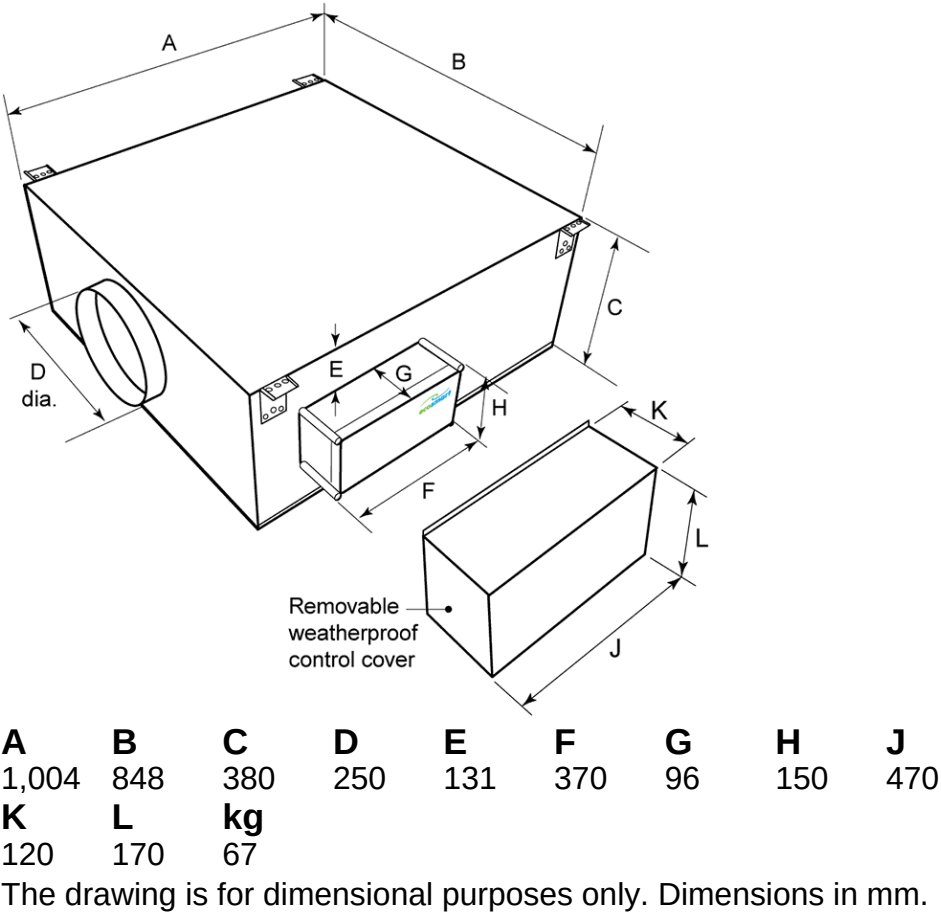
TOILET EXTRACT FAN
NUAIRE DE - DAVE EXTRA
DE - DAVE Extract Fan Plus with Ecosmart Control
Inline Centrifugal Extract Fan
Fan Code: DE4A-ES
Installation Manual Links: 611280
Required Duty: 0.224 m³/s @ 80 Pa
Actual Duty: 0.274 m³/s @ 120 Pa
Actual at Required Flow: 0.224 m³/s @ 212 Pa
Velocity at Actual Duty: 5.584 m/s
When Speed Controlled to Required Duty (81.7%):
Velocity at Required Duty: 4.563 m/s
Motor Input Power: 0.1 kW
Specific Fan Power: 0.4 W/(l/s)
Motor Efficiency: 0 %
Motor Input Power: 0.182 kW
Specific Fan Power: 0.7 W/(l/s)
Nominal Fan Speed: 2,550 RPM
Electrical Supply: 230 V 1 Phase 50 Hz
Motor Rating: 0.17 kW
Motor Current: flc: 1.35 A
Motor Current: sc: 1.35 A
Max. Operating Temp.: 60°C
Acoustic performance to ISO 13347 and AMCA 300.

Dave high performance extract fan, extended casing configuration type 'A' with patented 'Floating fan' construction. Single skin, with infill panels and manufactured from heavy gauge, corrosion resistant Aluzinc steel. Units have integrated attenuation pods to reduce noise breakout. The unit is suitable for internal or external mounting, in any orientation and incorporates a full length top or bottom access panel. The fan impeller and EC motors are selected to provide optimum performance and energy efficiency conforming to Part L regulations. Units are suitable for operation in ambient temperatures of up to 60°C (sizes 1-5), 40°C (sizes 6-7) and are Class L2 leakage. The unit shall be controlled by an integrated Ecosmart control mounted externally to the case. The fans shall have the following energy saving and operational functions integrally installed with in it, all components will be pre-wired and fitted by the manufacturer:

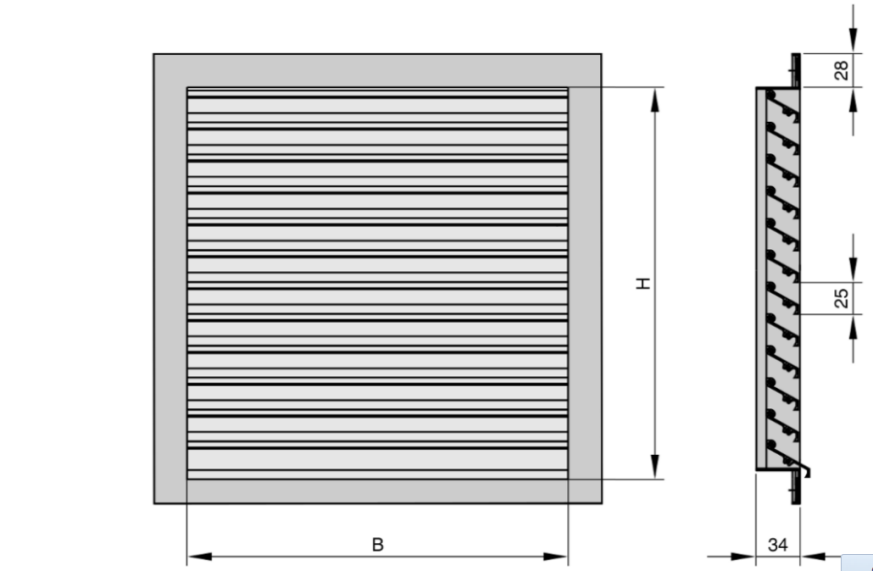
- Integral Frequency inverter/speed controller.
- Integral adjustable run-on timer.
- Maximum and minimum speed adjustment/setting (trickle and boost).
- Volt free run & failure/status indication.
- 0-10V BMS interface for remote operation.
- Multiple low voltage sockets for interconnection of sensors or fans.
- Background ventilation/trickle enable switch.

The unit is supplied with G3 filter, circular spigots and set of four mounting brackets. The Fan unit shall have a 5 year warranty.

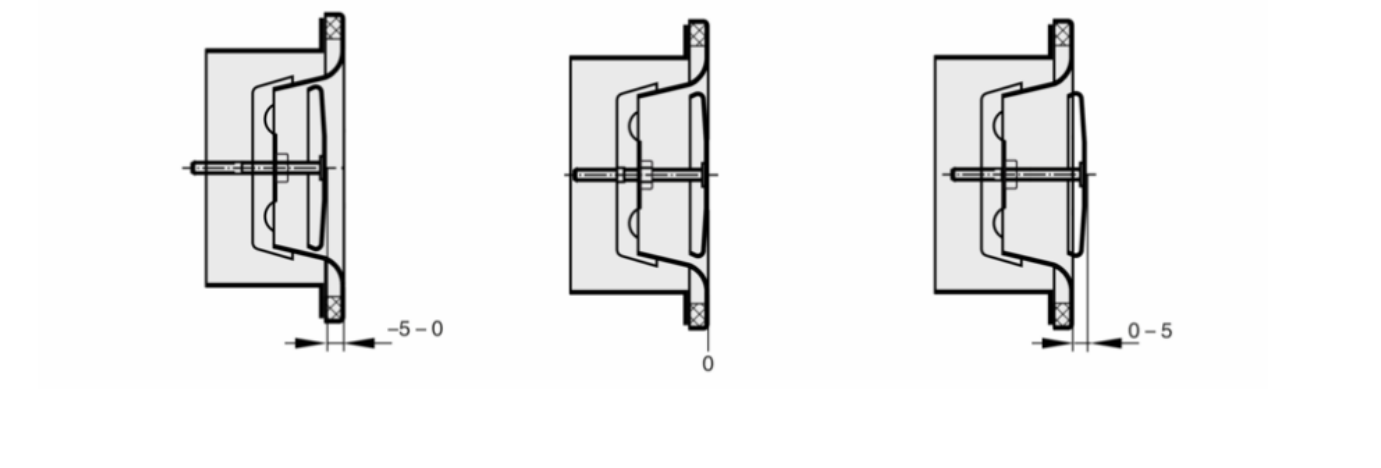
Fan Dimensions



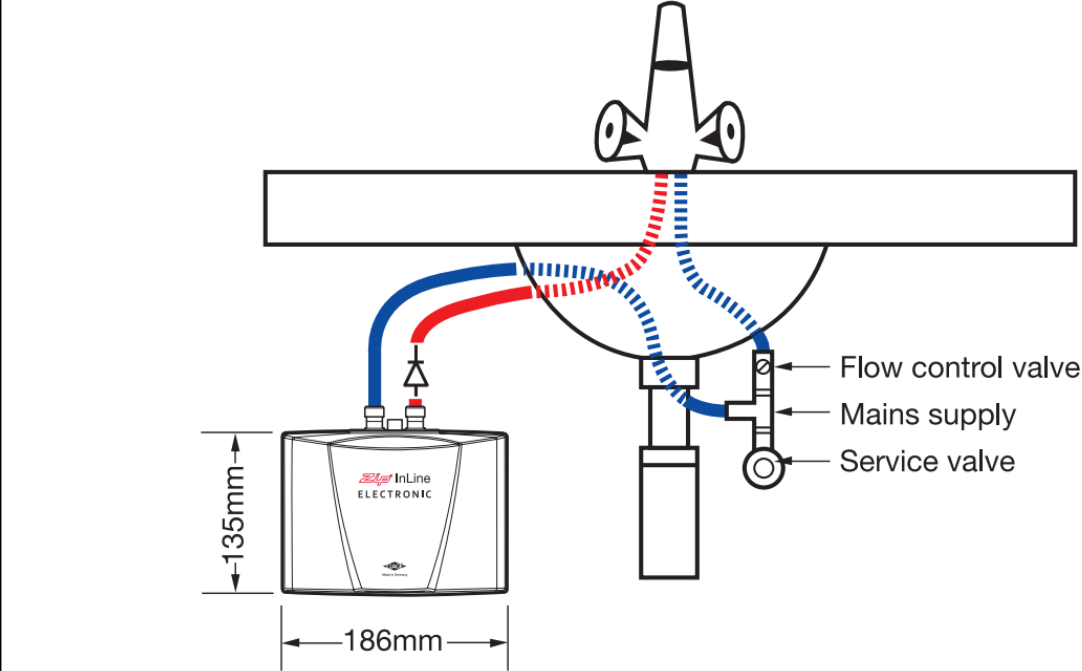
EXTRACT LOUVRE
TROX - WGKL-AL
Rectangular external weather louvre as a protection of air conditioning systems against the direct ingress of rain, leaves and birds into fresh air and exhaust air openings. Ready-to-install component which consists of a border, aerofoil rain defence blades, and a bird mesh at the rear.
SPECIAL CHARACTERISTICS
- Low differential pressure and low air-regenerated noise due to aerofoil blades
- Simple and quick installation due to perimeter border
- Silicone free
MATERIALS AND SURFACES
- Border, blades and stabilising mullions made of extruded aluminium sections, material no. EN AW-6060 T66, anodised to EURAS standard, E6-C-0, natural colour
- Wire mesh made of galvanised steel
- Border fixing holes
VARIANT
ALMaterial: Aluminium
Construction: Wire mesh, galvanised steel
Border: With fixing holes
997Width: 997
197Height: 197
ERInstallation subframe: With
P1Surface: Powder-coated to RAL 9006 (GL 30%), RAL 9010 (GL 50%), other colours to RAL... (GL 70%)
RAL 9010Select state colour: RAL 9010
PRODUCT DATA
Strategy: Given volume flow
Installation type Ducted, exhaust air (A)
Volume flow qv 270 l/s
Airflow velocity v 1.37 m/s
Free area Afr 0.0793 m²
Width of installation opening binst 1,025 mm
Height of installation opening hinst 225 mm
Acoustic results
Air-regenerated noise
Δpt [Pa] 7
LW,A [dB(A)] 36
63Hz [dB] 23
125Hz [dB] 33
250Hz [dB] 24
500Hz [dB] 28
1kHz [dB] 35
2kHz [dB] < 15
4kHz [dB] < 15
8kHz [dB] < 15
LW,NC [dB] 34
LW,NR [dB] 35
Manufacture of the planning: TROX
Type: WGK-AL/997x197/ER/P1-RAL9010



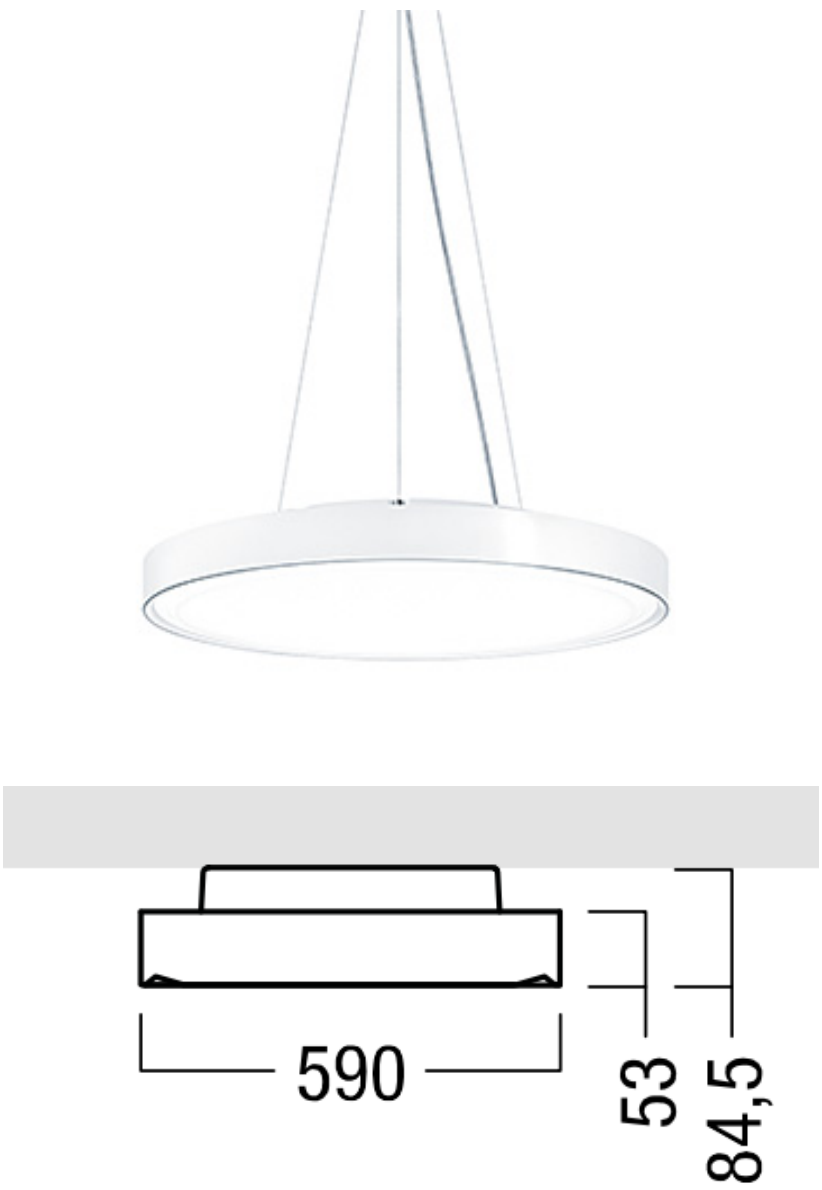
EXTRACT VALVE GRILLE
TROX - LVS
Circular disc valves as extract air devices, preferably for small rooms. For installation into walls and suspended ceilings. Ready-to-install component which consists of a valve casing with cross bar, a valve disc with threaded spindle, and an installation subframe. The valve disc can be turned for volume flow rate balancing. The valve setting can be fixed with a lock nut. Spigot suitable for ducts to EN 1506 or EN 13180. Sound power level of the air-regenerated noise measured according to EN ISO 5135.
SPECIAL CHARACTERISTICS
- Continuous volume flow rate balancing by turning the valve disc
- Easy to install
MATERIALS AND SURFACES
- Valve casing and valve disc made of galvanised sheet steel
- Installation subframe, cross bar, threaded spindle and lock nut made of galvanised steel
- Foam seal
- Valve casing and valve disc powder-coated RAL 9010, pure white
VARIANT
Nominal size:200
PRODUCT DATA
Volume flow qv 50 l/s
Gap width s 20.0 mm
Acoustic results
General
Δpt [Pa] 8
LWA [dB(A)] < 15
63Hz [dB] 21
125Hz [dB] < 15
250Hz [dB] < 15
500Hz [dB] < 15
1kHz [dB] < 15
2kHz [dB] < 15
4kHz [dB] < 15
8kHz [dB] < 15
LWNC [dB] < 15
LWNR [dB] < 15
Manufacture of the planning: TROX
Type: LVS/200



POINT OF USE (POU) WATER HEATER
ZIP INLINE ES3
Zip Model ES3
Pressure rating 10 bar
Element type Bare wire
Supply voltage 1/N/PE 230V~
Nominal power rating @ 230V 2.8kW
Nominal current @ 230V 12A
Temperature adjustment (installer) 30°C - 45°C
Maximum inlet temperature 70°C
Factory set temperature 38°C
Factory set flow rate 38°C 1.5 litres/min
Maximum temperature increase @ 230V and a flow rate of:
2.0 litres/min 20°C
2.5 litres/min 16°C
3.0 litres/min 13°C
3.5 litres/min 11°C
4.0 litres/min 10°C
Switch on flow rate 1.2 litres/min
Switch off flow rate 1.0 litres/min
Required specific water resistance @ 15°C >1100 ohm.cm
Capacity 0.2 litres
Filled weight 1.5kg
Water connection 1/2"BSP
Dimensions (H x W x D) 135mm x 186mm x 87mm
Protection class (IEC 529) IP25
All data quoted at nominal supply voltage.
A minimum water pressure of 0.2 MPa (2bar) is recommended for optimum performance.
The appliance must not be subject to more than 1 MPa (10bar).
Description
• The ES is designed to provide hot water for handwash in areas where space is limited
• Heating power controlled electronically for temperature stabilisation
• Outlet temperature can be preset inside the unit between 30°C and 45°C (factory set at 38°C)
• Flow adjustment control, preset for a temperature increase of 25k
• Stainless steel bare-wire heating system for very quick response
• Double pole thermal cut-out protection
• Choice of special kits available complete with heater, tap and fittings
• Supplied with 700mm of pre-wired cable
• Easy to install with improved wall bracket
Approvals WRAS approval and CE endorsed.



SUSPENDED LED LIGHT FITTING - A
ZUMTOBEL ONDA2 P LRO D590 LED4000-830 LDE WH
Decorative diffuse LED Circular luminaire with LRO cover for pendant mounting. Luminaire input power: 32.1 W, DALI controllable luminaire with LED converter; LED service life lasts 50000 h before luminous flux is reduced to 90% of the initial value. Chromaticity tolerance (initial MacAdam): 3. Luminaire luminous flux: 3970 lm, Luminaire efficacy: 124 lm/W. Colour rendering Ra > 80, colour temperature 3000 K. aluminium housing in white enamelled finish. Plastic cover, LRO light reducing optic with UGR<19 in polymethylmethacrylate with frosted surface, fixed to frame. Includes electronic LED converter for DALI control. Luminaire wired with halogen-free leads Dimensions: Ø590 x 85 mm weight: 5.8 kg;
To be supplied with pendant set.
Light Source: LED
• Luminaire luminous flux*: 3970 lm
• Luminaire efficacy*: 124 lm/W
• Colour Rendering Index min.: 80
• Ballast: 1 x 28000657 DRV TR LCA 75W 400mA 220V
D #04A lp PRE
• Correlated colour temperature: 3000 Kelvin
• Chromaticity tolerance (initial MacAdam): 3
• Rated median useful life*:
L90 50000h at 25°C
• Luminaire input power*: 32.1 W Power factor = 0.98
• Standby Power*: 0.15 W
• Dimming: LDE dimmable to 1%
over DALI, DSI and switchDIM
DC level is adjustable
• Maintenance category: D - Enclosed IP2X



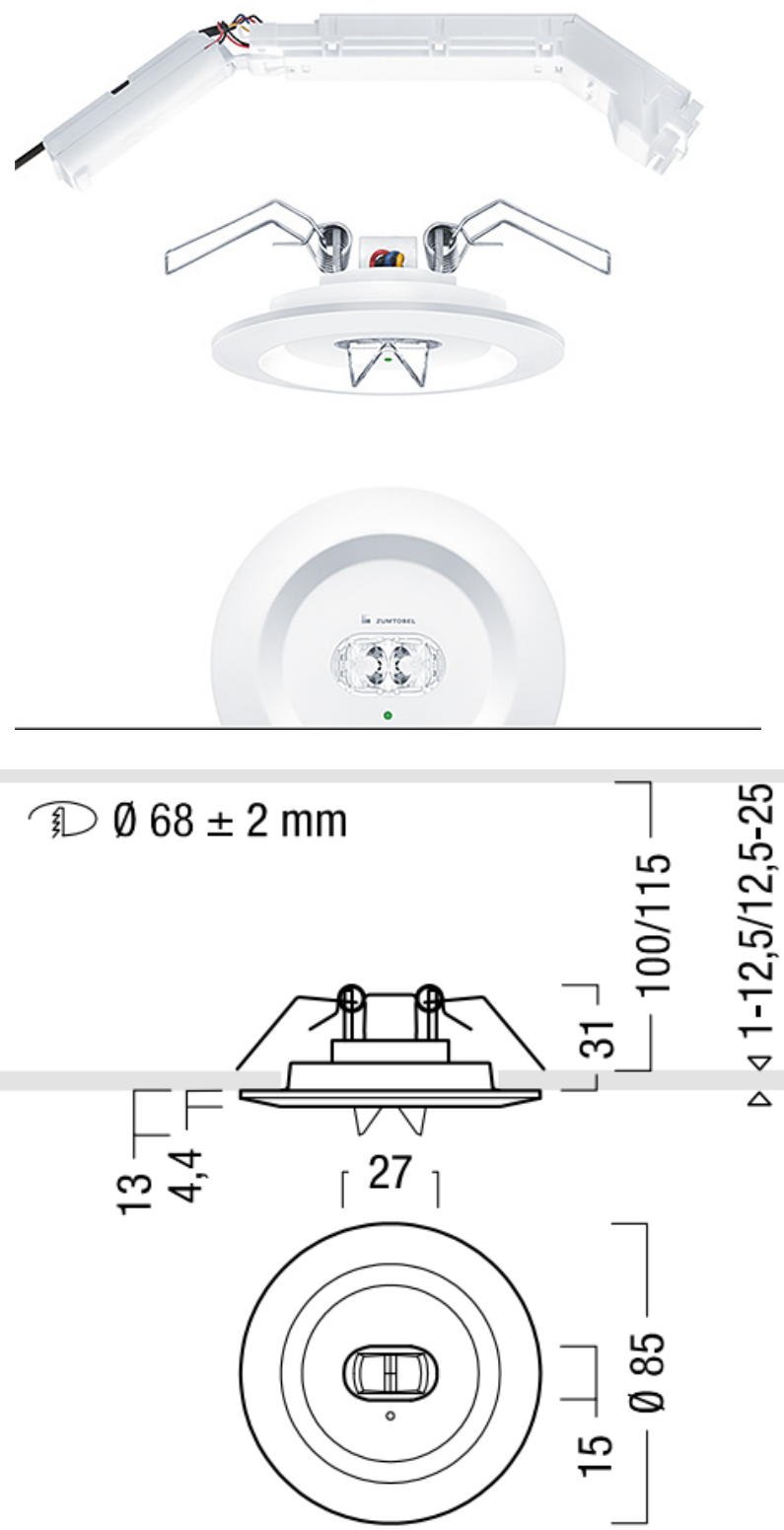
Refer to MEP Materials and Workmanship specification for details on the below.

- 1. FUSED POWER SUPPLY FOR POU WATER HEATERS
- 3. FUSED POWER SUPPLY FOR HAND DRYERS
- 4-1. FUSED POWER SUPPLY FOR DOOR OPENER
- 4-2. DOOR OPENER PUSH BUTTON
- 5. FUSED POWER SUPPLY FOR FAN
- 6. DISABLED ALARM SYSTEM
- 7. CLEANERS SOCKET

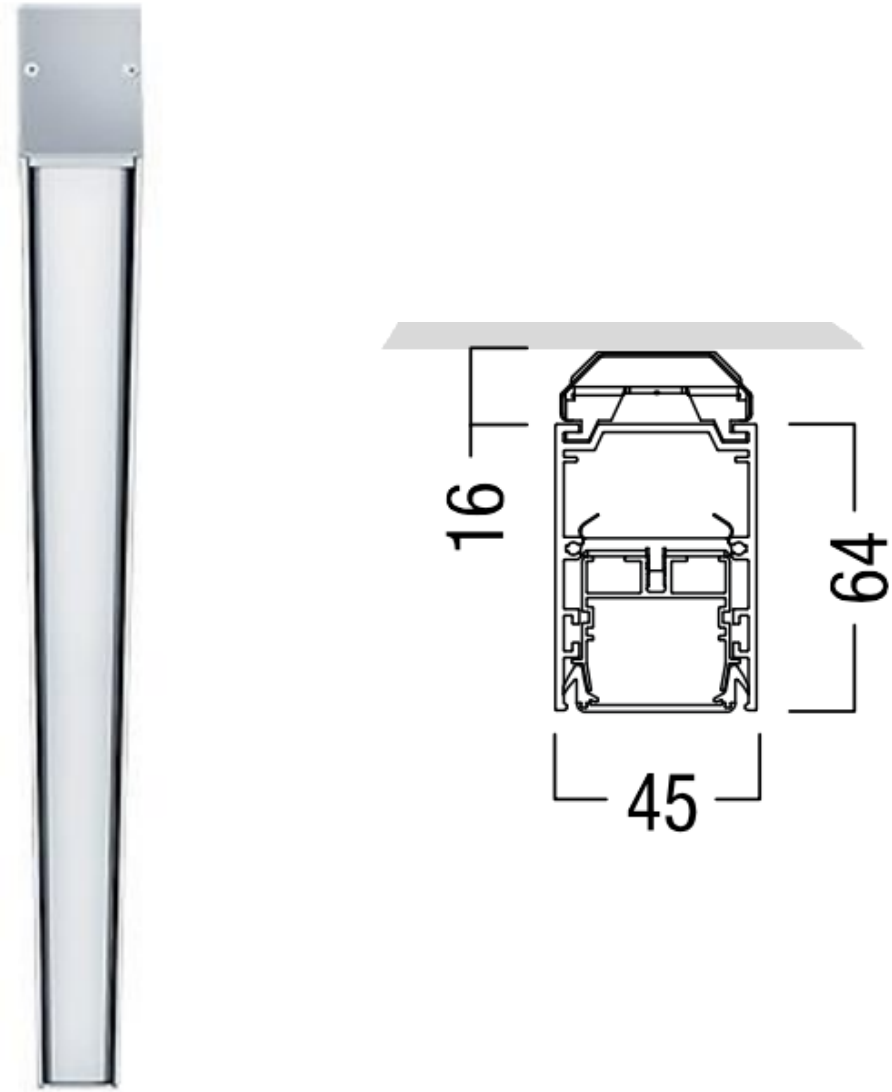
E. LIGHT SWITCH

A 3 gang 2 way light switch shall be use to provide lighting control over the main room, the toilet pods and the baby change.
Where fixtures are visible finishes shall be brushed stainless steel.

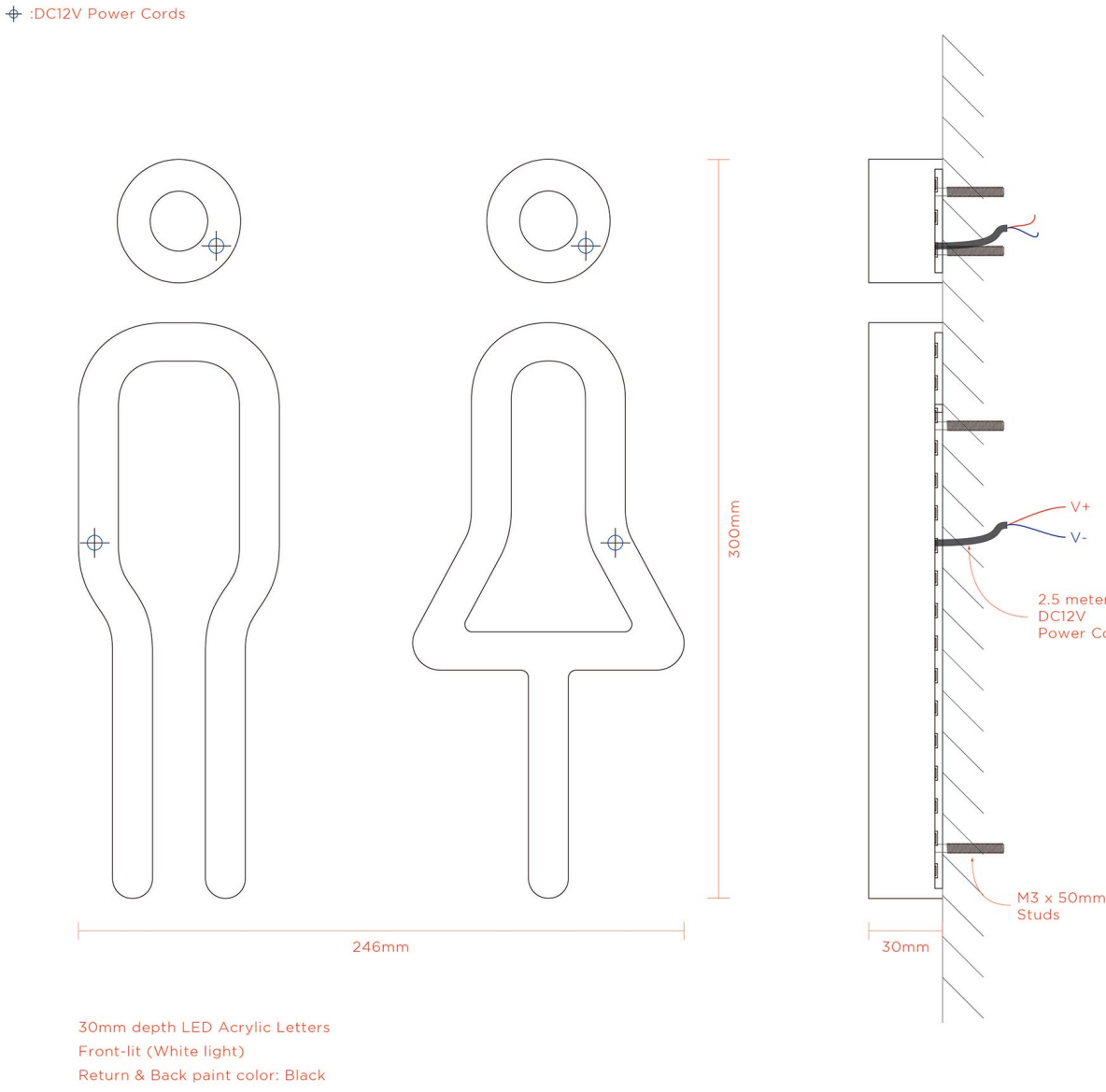
RECESSED LED SPOTLIGHT (+EMERGENCY) - B / B-E
ZUMTOBEL RESCLITE PRO MRCR ESC E3D WH
Safety luminaire
LED emergency luminaire for escape route lighting with min. 1 lux compliant to EN 1838; Room height 2.2 to 7 m; 2 high power LEDs, neutral white 4,000 K; lens of polycarbonate; optimum thermal management via heat sink; Ceiling recessed luminaire for 68mm ceiling cut-out and ceiling thickness from 1 - 25 mm; tool-free rapid luminaire installation through specially shaped retaining springs; tool-free replacement of battery and control unit; Cover ring diecast aluminium, powder-coated; housing colour white (close to RAL9016); Polypropylene (PP) gearbox for installation in ceiling recess; Luminaire with local battery supply for 3 h emergency lighting in maintained or non-maintained mode, with automatic test (auto-test) via the luminaire, optional central monitoring via DALI, display of luminaire status via status LED; NFC interface for addressing, configuration and maintenance via PROset Pen (article no.: 22170290) or PROset app; addressing also alternatively possible visually or via EZ-addressing; Maintained and non-maintained mode: +5°C to +35°C; power supply: 220-240 V AC (+/- 10%), 50-60 Hz; Luminaire input power: 4.7 W; Non-maintained and maintained mode settable via jumper and NFC interface; IP40; SC1; Luminaire wired with halogen-free and silicone-free leads; Plugin terminals for through-wiring up to 2.5 mm²; Impact strength: IK04; Dimensions: Ø85 x 4 mm; weight: 0.38 kg; Suitable for installing in concrete casting surround (separately ordered);
Light Source: LED
• Luminaire luminous flux*: 183 lm
• Total emergency luminous flux: 183 lm
• Luminaire efficacy*: 39 lm/W
• Colour Rendering Index min.: 70
• Ballast: 1 x 89800524 EM TR EM powerLED NTx 102
DIM 5W ZUM
• Chromaticity tolerance (initial MacAdam): 5
• Rated median useful life*:
L90 50000h at 25°C
• Luminaire input power*: 4.7 W Power factor = 0.7
• Standby Power*: 1.2 W
• Charging power: 1.25 W
• Service life rating: 3 h



CHANNEL LIGHT VERTICAL & RECESSED - C-V / C-R
ZUMTOBEL SLOIN slim K L2500 SRE
SURFACE MOUNTED MODEL
Channel for LED light line made of aluminium for installing in plasterboard ceilings, for surface-mounting and suspending, silver powder coated. End cap set not included; Luminaire wired with halogen-free leads. Dimensions: 2500 x 45 x 64 mm. Weight: 2.8 kg. SLOIN slim consists of a channel, LED-batten, cover and accessories, which have to be configured and ordered separately. This product is one part of the complete configuration.
Light Source: LED
• Luminaire luminous flux*: 4140 lm
• Luminaire efficacy*: 81 lm/W
• Colour Rendering Index min.: 80
• Correlated colour temperature: 2700 Kelvin
• Chromaticity tolerance (initial MacAdam): 3
• Rated median useful life*:
L85 50000h at 25°C
• Ballast: 2x LED_Con
• Luminaire input power*: 51.2 W Power factor = 0.98
• Standby Power*: 0.32 W
• Dimming: LDE dimmable to 1%
over DALI, DSI and switchDIM
DC level is adjustable



DOOR SIGNAGE - F
NETTO LED ILLUMINATED RESTROOM SIGN - TWIN FORMAT
Manufactured from 30mm deep Perspex Spectrum LED acrylic, embedded with premium white LED's for a dramatic even, bright white illumination. Side returns are finished black with a weather resistant PVDF paint. Supplied complete with 2500mm long low voltage cables and electronic drivers for remote connection, drilling template and fixing studs. With a warranted life of 50,000hrs, our product is CE certified and IP67 rated for weather resistance.



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JOB TITLE: NML EVENTS WELFARE FACILITIES MLK BUILDING - TEMPORARY TOILETS

SKETCH TITLE: ELECTRICAL PLANT SCHEDULE

JOB NUMBER: 0047122

SKETCH NUMBER: MLK-WEL-006

DATE: 15/12/2020

INITIALS: RS

R11 ABOVE GROUND FOUL DRAINAGE

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R11.1 PART 1 – GENERAL

R11.1.1 RELATED DOCUMENTS

- A For drawings and general provisions of the contract refer to main contract preliminaries.
- B Refer also to the following sections:
 - 1 Refer also to:
 - a Y10 – Pipelines for supports and spacings
 - b Y32 – Mechanical plant and equipment identification
 - c Y41 – Building Monitoring and management systems
 - d Y50 – Mechanical commissioning
 - e Y90 – fixing to building.

R11.1.2 SUMMARY

- A This section includes above ground foul and ventilating pipework and fittings.
- B For below ground drainage, refer to civil engineer's specification.

R11.1.3 DEFINITIONS

- 1 Black water: Foul discharges from the following sanitary appliances:
 - a WCs
 - b Urinals
 - c Bidets
 - d Bedpan washers
 - e Kitchen equipment and cleaners sink units.
 - f Dishwashers and potwashers
 - g Floor/shower/channel drains
 - h Chemical discharges
 - i Swimming pool backwash
 - j Temperature/pressure relief drains.
- 2 Grey water: Wastewater discharges from the following:
 - a Wash hand basins
 - b Showers
 - c Baths
 - d Condensate drains
 - e Clothes washers.

R11.1.4 DESIGN REQUIREMENTS

- A The design of the above ground system foul drainage shall be to meet the requirements of BS EN 12056 and the Building Regulations. When the project incorporates grey water recovery and treatment and where indicated on the drawings and specification, the foul drainage systems may be divided into "black" and "grey" water systems. Where this is not indicated the systems are combined foul systems taking black and grey water.
- B The systems shall be sized on the discharge unit method. The discharge units used are those identified as BS EN 12056-2 System III Table 2.
- C The foul above ground drainage system shall discharge to the foul below ground drainage system.
- D Waste water from the commercial kitchens shall be separately piped and discharged. Discharges containing grease from dishwasher and potwash equipment shall be treated to remove fats, oils and grease (FOG).

- E Connect condensate drainage from HVAC equipment and the like to the foul drainage system via traps or a self-sealing waste valve.
- F Where a grey water collection and treatment system is provided this will be indicated on the drawings and specification.

R11.1.5 PERFORMANCE REQUIREMENTS

- A The above ground foul drainage shall discharge by means of gravity into the below ground drainage system. Where necessary, pumps may be used to lift the effluent to an appropriate level for gravity discharge.
- B The foul drainage above ground system shall be installed to meet the performance requirements stated in BS EN 12056, the Building Regulations Part H, water supply (water fitting) regulations and all other technical manuals, BBA Certificates and guides applicable.
- C The system shall be installed using the minimum pipework, fittings and accessories necessary to carry away all discharges from the sanitary appliances and floor drains, quickly, quietly and with freedom from nuisance or risk to health.
- D It is essential that foul air from the foul drainage system is prevented from entering the building by means of traps at all connections.
- E All drainage shall ventilate to atmosphere by one of the following means:
 - 1 System of ventilating pipework
 - 2 Combined discharge and vent pipe.
- F Main ventilating pipework shall be installed to suit the design of both the above and below ground drainage systems as necessary and shall terminate to atmosphere.
- G All drainage discharges from plantrooms and mechanical equipment shall be connected to the foul drainage system.

R11.1.6 SUBMITTALS

- A Product data for each type of product listed:
 - 1 Pipelines and jointing methods
 - 2 Exposed to view pipework internally and externally
 - 3 Grease treatment systems.
- B Co-ordinated working drawings: For drainage systems. Include plans, elevations, sections, and details.
- C Field test reports and certificates: indicate and interpret test results for compliance with performance requirements. Include "Contractor's Material and Test Certificate for Aboveground Piping".
- D Field quality-control reports.
- E Operation and maintenance data: For pipework and system components to include in operation, and maintenance manuals.

R11.1.7 QUALITY ASSURANCE

- A Piping materials shall bear label, stamp, or other markings of one of the specified testing agencies:
 - 1 Kitemark
 - 2 British Standards
 - 3 European Standards
 - 4 DIN standard
 - 5 British Board of Agreement.

B Quality standards:

- 1 BS EN ISO 9001: Quality Systems
- 2 BS EN 877+A1:2006: Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings. Requirements, test methods and quality assurance
- 3 BS EN 681/ISO 4633: Elastomeric seals. Material requirements for pipe joint seals used in water and drainage applications
- 4 BS EN 12056: Code of practice for gravity drainage systems inside buildings
- 5 BS 4514: Unplasticised PVC soil and ventilating pipes of 82.4mm minimum mean outside diameter, and fittings and accessories of 82.4mm and of other sizes. Specification
- 6 BS EN 1329+A1:2018: Plastic piping systems for soil and waste discharge (low and high temperature) within the building structure. Unplasticised poly(vinyl chloride) (PVC-U) BS 5255: Specification for thermoplastics waste pipe & fittings
- 7 BS EN 1455-1: Plastic piping systems for soil and waste (low and high temperature) within the building structure. Acrylonitrile-butadiene-styrene (ABS)
- 8 BS 5627: Specification for plastics connectors for use with horizontal outlet vitreous china WC pans
- 9 BS EN 1451-1: Plastic piping systems for soil and waste discharge (low and high temperature) within the building structure. Polypropylene (PP). Specifications for pipes, fittings and the system BS EN 274 Parts 1 to 3. Waste fittings for sanitary appliances. Requirements
- 10 BS EN 14680: Adhesives for non-pressure thermoplastic piping systems. Specifications BS EN 681-1: Material requirements for pipe joint seals used in water and drainage applications. Part 1 vulcanised rubber
- 11 BS EN 1057+A1:2010: Specification for copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications
- 12 BS EN 1254-2: Specification for copper and copper alloys. Plumbing fittings. Fittings with compression ends for use with copper tubes
- 13 BS EN 1561: Specification for cast iron material.

R11.1.8 CO-ORDINATION

- A Co-ordinate layout and installation of all pipework and components with other construction and ensure components are located correctly in accordance with the relevant standards.

R11.2 PART 2 – PRODUCTS

R11.2.1 PVC-U SOIL WASTE AND VENT PIPES

- A Pipe and fittings: unplasticised PVC to BSEN 1329-1+A1:2018, BS 4514 and BSI certification (Kitemark).
- B Application: vertical soil and vent pipes, vertical waste and vent pipes, and suspended high level pipes for sizes 110 and 160mm. For extent of PVC use refer to section B of this specification and the drawings.
- C Manufacturer:
- 1 Marley
 - 2 Hepworth - HepSoil
 - 3 Polypipe
 - 4 Wavin.
- D Pipework system details:
- 1 Jointing system: Solvent - welded piping for sizes 110 & 160mm, plain ends:
 - a Use manufacturer's approved cleaner and solvent cement
 - b Use MuPVC pipework for sizes less than 110mm
 - c Comply with manufacturer's instructions
 - d Provide ring seal expansion couplings to accommodate thermal movement.
 - 2 Pipe fittings: Manufacturer's standard, injection moulded to BS EN 1329-1+A1, BS 4514
 - 3 Colour: Black/grey
 - 4 Expansion joints: Expansion must be catered for by use of ring seal type expansion joints located in accordance with BS EN 12056. The rubber seals for seal ring joints shall be of section that gives more than one point of contact with the pipe and shall be to the material requirements of BS 7874, BS EN 681-1, and BS EN 681-2. Horizontal and vertical pipework shall include allowance for thermal expansion in accordance with the manufacturer's recommendations. All expansion units shall be anchored
 - 5 Limitations:
 - a Do not use externally due to effect of solar radiation
 - b Do not use in hospitals or for high temperature discharges (>60°C)
 - c Do not use where noise intrusion may be unacceptable.
 - 6 Fire rating: Intumescent fire collars must be used where pipework greater than 40mm penetrates fire rated walls and floors
 - 7 Supports use manufacturer's standard brackets. Fixing and spacing in accordance with manufacturer's instructions.

R11.2.2 MUPVC – BRANCH WASTE AND VENT PIPES

- A Pipe and fittings: Modified unplasticised PVC to BS EN 1329+A1:2018, BS EN 1455-1, BS EN 1519-1, BS EN 1565-1, BS EN 1566-1, BS EN 1451-1 and BSI certification (Kitemark).
- B Application: Branch waste and vent pipes 50mm and less. For extent of MuPVC use refer to section B of this specification and the drawings. For exposed to view pipework use chromium plated copper.
- C Manufacturer:
- 1 Marley
 - 2 Hepworth - HepSoil
 - 3 Polypipe
 - 4 Wavin.
- D Pipework system details:
- 1 Jointing system: Solvent -welded piping for sizes 32, 40 & 50mm plain ends:
 - a Use manufacturer's approved cleaner and solvent cement
 - b Comply with manufacturer's instructions.

- 2 Pipe fittings: Manufacturer's standard, injection moulded to BS EN 1329-1+A1:2018; BS 5255see above
- 3 Colour: Black/grey
- 4 Limitations:
 - a Do not use externally due to effect of solar radiation
 - b Do not use in hospitals or for high temperature discharges (>60°C).
- 5 Expansion joints: expansion must be catered for by use of ring seal type expansion joints located in accordance with BS EN 12056. The rubber seals for seal ring joints shall be of section that gives more than one point of contact with the pipe and shall be to the material requirements of BS 7874, BS EN 681-1, and BS EN 681-2. Horizontal and vertical pipework shall include allowance for thermal expansion in accordance with the manufacturer's recommendations. All expansion units shall be anchored
- 6 Supports: Use manufacturer's standard brackets. Fixing and spacing in accordance with manufacturer's instructions.

R11.2.3 WC SOIL PIPE CONNECTERS

- A Material: WC connectors 100 mm diameter high density polyethylene, white connectors or approved equivalent.
- B Manufacturers: Multikwick or approved equivalent.

R11.2.4 CONNECTIONS TO UNDERGROUND DRAINAGE SYSTEMS

- A Connection to underground or under building drainage systems shall be made using the manufacturer's proprietary couplings/adaptors as recommended by the manufacturer of the piping system used.

R11.2.5 SANITARY FITTINGS

- A Sanitary fittings may be included in this scope of works or may be included in a separate subcontract.
- B If required by the conditions of contract provide the sanitary ware in accordance with the schedule of equipment which may be included in section D of this specification or in the architectural specification. Use only the manufacturers and models indicated.
- C Care shall be taken to ensure that pipework is not used as means of support for the sanitary appliances.
- D When installed the sanitary fittings shall comply with the requirements of BS EN 806-5, BS8558 and the Water Supply (Water Fittings) Regulations, (Water Byelaws, Scotland) particularly in respect of protection against water contamination by back siphonage, backflow or cross connection and wastage. Urinal automatic flushing cisterns shall be fitted with a flush control device.

R11.2.6 SANITARY FITTING OVERFLOWS

- A Overflows from basins, sinks and the like shall be built into sanitary fitting and shall discharge into the waste outlet before the fitting trap. Overflows from baths shall be specified in the bath sanitary ware specification.

R11.2.7 ACCESSORIES

- A Use appropriate adaptors to connect to the specified drainage pipework.

R11.2.8 TRAPS

- A Traps to wash hand basins and urinals in toilet areas, to be chrome plated where exposed to view or where specified by the architect but installed under this specification.

- B Traps in other locations shall be moulded from white polypropylene or be copper with brass nuts in accordance with BS EN 274. The traps shall bear the British Standard Kite Mark certification.
- C Traps shall have seal depths and diameters in accordance with BS EN 12056-2. Deep seal trap (75mm).
- D Traps shall be fitted with a universal compression outlet in accordance with the following unless otherwise specified:
- 1 Wash hand basins - 32mm deep seal resealing trap
 - 2 Sinks - 40mm deep seal tubular trap
 - 3 Urinals - 40mm deep seal tubular or bottle trap
 - 4 Bidets - 32mm deep seal tubular trap
 - 5 Baths - 40mm deep seal tubular trap
 - 6 Showers - 40mm deep seal trap with top access
 - 7 Dishwashers - 40mm deep seal tubular trap and stand pipe
 - 8 Washing machines - 40mm deep seal tubular trap and stand pipe
 - 9 Plantroom floor gullies - 100mm cast iron trap with 50mm seal and bottom access
 - 10 For condensate or for other situations where there is insufficient water flow to replenish a traditional water seal trap, self-sealing waste valves shall be used subject to approval of local Building Control:
 - a Manufacturer: Hepworth
 - b Type: HEPVO.

R11.3 PART 3 - EXECUTION

R11.3.1 BELOW GROUND PIPEWORK

- A Comply with requirements in the civil engineer's specification. Obtain all details of the underground systems and ensure that connections are compatible and use the appropriate couplings.
- B Ensure that below ground drainage is ready to receive foul drainage. Ensure any specific painting of surfaces, which shall be concealed or otherwise made inaccessible, is completed.
- C Prevent entry of foreign matter into any part of system by sealing openings during construction. Fit all access covers and cleaning eyes as work proceeds. Failure to undertake this will result in the requirement for CCTV inspections to be carried out to the entire system, to prove that the system is free from debris.

R11.3.2 ABOVE GROUND PIPING INSTALLATION

- A Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B Install piping in concealed locations, service risers, ceiling voids unless otherwise indicated and except in equipment rooms and service areas.
- C Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D All foul drainage pipework shall be installed to convey discharges without crossflow, backfall, leakage or blockage and it is essential that the system is adequately tested, cleaned and maintained at all times and throughout the construction process.
- E Install pipes, fittings and accessories in accordance with BS 8000 Part 13, BS EN 12056-2 and manufacturer's recommendations to ensure the complete discharge of foul drainage from the building without any leaks, ingress to the building or nuisance.
- F Obtain all components for each type of pipework from the same manufacturer, unless otherwise indicated. Inspect components carefully before fixing and reject any which are defective. Ensure cut ends of pipes are clean and square with burrs removed.
- G The pipes shall be fixed in straight runs and all horizontal runs are to be laid to gradients in accordance with BS EN 12056-2 and this specification (typically 18mm/m for WCs and 22mm/m for all other wastes). Horizontal branches should be connected with 45/135° branch swept in the direction of flow.
- H Allow for thermal and building movement when jointing and fixing drainage pipework in accordance with the manufacturer's recommendations. Use a flexible coupling either side of the joint.
- I Form junctions using fittings intended for the purpose, ensuring that jointing material does not project into bore of pipes and fittings.
- J Avoid contact between dissimilar metals and other materials, which would result in electrolytic corrosion.
- K Handle, store and securely fix all products and accessories in accordance with manufacturer's recommendations.
- L All pipework and fittings shall be properly cleaned, where necessary following completion of the installation.

R11.3.3 PIPE ROUTES

- A Ensure pipe routes are shortest practicable, with the minimum number of bends, unless indicated otherwise.

- B It is a requirement of this specification that all branch connections to horizontal runs at high level on any floor shall be made using 45° branches swept in the direction of flow, where possible.

R11.3.4 FIXINGS

- A Fix pipes at centres not greater than those specified in BS 8000 Part 13. Provide additional supports as necessary at junctions and changes in direction. Fix every length of foul drainage pipework at, or close below the socket collar.
- B Where not indicated otherwise, use plated, sheradised, galvanised or non-ferrous fastenings, suitable for the purpose and background, and compatible with the material being fixed or fixed to.
- C Vertical fixings shall be fixed via purpose-made two-piece fixing brackets as supplied by the pipe and fitting manufacturer or similar.
- D Horizontal fixings shall be fixed via purpose made two-piece galvanised mild steel bolted drop rod type clips, drilled to accept M10/M12 rod.
- E Where horizontal pipes are installed in excess of 500mm from the soffit of the supporting slab adequate supports shall be provided to prevent lateral movement.
- F Install adequate restraint couplings to ensure that the system is capable of withstanding all likely accidental static water pressures.
- G Where foul drainage pipework is required to be installed prior to the erection of supporting walls, supply and install independent adequate galvanised mild steel support framework from floor slab to soffit.

R11.3.5 FIRE SAFETY

- A Provide and install protection of openings and fire stopping in accordance with the Building Regulations.
- B Provide and install on all plastic pipework passing through fire compartment floors or walls and exceeding 40mm internal diameter an intumescent fire sleeve having an appropriate BBA certificate. The fire sleeve shall have a fire rating compatible with the floor, wall or cavity barrier to which it is fitted.

R11.3.6 EARTH BONDING

- A All new metal drainage systems pipework shall be continuity bonded and tested to ensure earth continuity in accordance with BS 7430+A1, BS 7671+A1 and this specification.
- B Carry out equipotential bonding and tests of the foul drainage system (above ground) in accordance with BS 7671+A1 to prove the effectiveness of the earthing system. All tests shall be fully recorded and included within the operating and maintenance manuals.

R11.3.7 ACCESS POINTS

- A In convenient locations, provide access covers and cleaning eyes as necessary to permit adequate testing and cleaning of pipework. Access doors shall generally be installed at the bottom of each vertical and on every floor and 1m above each change of direction on vertical pipes. Access doors shall be installed on horizontal pipework in accordance with the current Building Regulations, BS EN 12056 and as indicated. Removable access panels shall be co-ordinated with these drainage access points to enable maintenance to foul drainage pipework.
- B Rodding and access points shall be provided at all changes of direction to enable the whole system to be maintained.
- C Provide square door type access points as indicated on the drawings for main vertical drainage pipes or stacks.

R11.3.8 THERMAL INSULATION

- A Provide and install pipe insulation to pipework which could be prone to the formation of condensation or to prevent freezing. All insulated foul drainage pipes are to be labelled to aid identification. Labels shall be provided at a maximum of 3m centres.
- B Insulation shall be 25mm thick plain finish rigid fibre glass sections 915mm long of 80-110 kg/m³ density, split for fixing, neatly cut with mitres at all bends and fittings and fastened with 0.9mm galvanised wire, unless specified otherwise.
- C Insulation shall be protected with 0.8mm thick polyisobutylene (PIB) sheet, having a tensile strength of not less than 2.5N/mm². Note: PIB coat is to be encased in aluminium sheet or another robust finish determined by architect. The PIB sheet material shall be adhered to the external surface of the insulation and all joints shall be lapped secured and sealed by adhesive or solvent welding. All jointing, sealing materials and methods of application shall be strictly in accordance with the manufacturer's recommendations.

R11.3.9 ACOUSTIC INSULATION

- A Acoustic lagging to be provided in accordance with Building Regulations Approved Document part E where pipework penetrates habitable room between dwellings and where indicated on the drawings.
- B Label insulation to aid identification. Labels shall be provided at a maximum of 3m centres.
- C Insulation to comprise 50mm mineral wool having a density of 80-100kg/m³ with an outer mass barrier of sound barrier mat of superficial density 5 kg/m³. Joints between sections of sound barrier mat shall overlap at least 10mm and be sealed using a duct jointing tape.
- D Insulation shall be protected with 0.8mm thick polyisobutylene (PIB) sheet, having a tensile strength of not less than 2.5N/mm². Note: PIB coat is to be encased in aluminium sheet or another robust finish determined by architect. The PIB sheet material shall be adhered to the external surface of the insulation and all joints shall be lapped secured and sealed by adhesive or solvent welding. All jointing, sealing materials and methods of application shall be strictly in accordance with the manufacturer's recommendations.

R11.3.10 CONNECTIONS TO APPLIANCES

- A Unless contract conditions indicate otherwise all sanitary and kitchen appliances shall be supplied and installed by the main contractor.
- B The responsibility for the connection to the appliances is by the sub-contractor. Ensure that all couplings and connections are of the appropriate type and compatible with the sanitary and kitchen appliances.

R11.3.11 IDENTIFICATION

- A Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Y32 Section "Mechanical Plant and Equipment Identification".

R11.3.12 FIELD QUALITY CONTROL

- A Portions of testing and inspection requirements in this article are taken from model plumbing codes. Revise if requirements vary.
- B During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
- C Roughing-in inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
- D Final Inspection: arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

- E Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- F Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- G Test sanitary drainage and vent piping according to procedures outlined.

R11.3.13 CLEANING AND PROTECTION

- A Clean interior of piping. Remove dirt and debris as work progresses.
- B Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C Place plugs in ends of uncompleted piping at end of day and when work stops.
- D Consider using other piping or specify protection by shielding or lightweight insulation if piping surface temperatures are expected to exceed 140°F (60°C).
- E Exposed PVC Piping: Not to be used.

S10 HOT AND COLD WATER SUPPLY

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S10.1 PART 1 - GENERAL

A Related sections include the following:

- 1 Firefighting: S60-66
- 2 Domestic pipework: Y10
- 3 Thermal insulation: Y30
- 4 Tanks and cisterns: Y21
- 5 Pipework Cleaning and Chemical Treatment: Y12
- 6 Water treatment: S12 (Domestic services)
- 7 Refer also to:
 - a Y32 – Mechanical plant and equipment identification
 - b Y41 – Building Monitoring and management systems
 - c Y50 – Mechanical commissioning
 - d Y90 – fixing to building.

S10.1.2 SUMMARY

A Obtain records of the existing services and establish by survey the exact location of services prior to carrying out any work in the vicinity of the existing services. Determine if any services need to be relocated to take account of new structures or surface finishes.

B This Section includes:

- 1 Domestic water heaters:
 - a HWH6 electric small capacity (10-50 litres) unvented point of use storage water heaters
- 2 Water hammer arresters.

S10.1.3 DEFINITIONS

A GRP: Glass reinforced polyester.

B PVC: Polyvinyl chloride plastic.

S10.1.4 PERFORMANCE REQUIREMENTS

A Hot water to be distributed at 38°C.

B Cold water and hot water pressures at outlets should be minimised to conserve water and protect from excess pressure.

C Install water hammer arrestors where necessary to reduce the possibility of noise due to water hammer.

D Separate the cold-water systems from the hot services to prevent the temperature of cold water being raised by heat from adjacent pipework. In close proximity ensure pipework is thermally insulated.

S10.1.5 SUBMITTALS

A Product data: include rated capacities, accessories, fittings, and furnished specialties for each type of equipment indicated.

B Shop drawings: signed and sealed by a qualified professional engineer. Show fabrication and installation details for each item of equipment. Include:

- 1 Power, signal, and control wiring.

C Field quality-control test reports, testing and commissioning data.

D Method statement for chlorination.

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E Operation and maintenance data for all equipment.

S10.1.6 QUALITY ASSURANCE

A Comply with requirements of WRAS.

B Ensure that the whole installation complies with the following standards:

- 1 BS 6700 - Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages (Partially Replaced by BS EN 806)
- 2 BS EN 806-1: Specifications for installations inside buildings conveying water for human consumption Part 1: General
- 3 BS EN 806-2: Specifications for installations inside buildings conveying water for human consumption part 2: Design
- 4 BS EN 806-3: Specifications for installations inside buildings conveying water for human consumption. Pipe sizing. Simplified method
- 5 BS EN 806-4 - Specifications for installations inside buildings conveying water for human consumption. Installation
- 6 BS EN 806-5 - Specifications for installations inside buildings conveying water for human consumption. Part 5: Operation and maintenance
- 7 BS EN 14743 - Water conditioning equipment inside buildings. Softeners. Requirements for performance, safety and testing.

C Ensure that the installation complies with the relevant standards, including the following:

- 1 BS 853-1 - Specification for vessels for use in heating systems. Calorifiers and storage vessels for central heating and hot water supply
- 2 BS 5440: Installation of flues and ventilation for gas appliances of rated output not exceeding 60kW
- 3 BS 6144 - Specification for expansion vessels using an internal diaphragm, for unvented hot water supply systems
- 4 BS 6920-1 - Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water. Specification
- 5 BS 7074-1 - Application, selection and installation of expansion vessels and ancillary equipment for sealed water systems. Code of practice for domestic heating and hot water supply
- 6 BS 7671 - Requirements for electrical installations. IET Wiring Regulations. Seventeenth edition
- 7 BS EN 26 - Gas-fired instantaneous water heaters for the production of domestic hot water, fitted with atmospheric burners
- 8 BS EN 89 - Gas-fired storage water heaters for the production of domestic hot water
- 9 BS EN 14055 - WC and urinal flushing cisterns
- 10 BS EN 14154-1 - Water meters. General requirement
- 11 BS EN 15154-1 - Emergency safety showers. Plumbed-in body showers for laboratories
- 12 BS EN 15154-2 - Emergency safety showers. Plumbed-in eye wash units
- 13 BS EN 60335-2-35 - Household and similar electrical appliances. Safety. Particular requirements for instantaneous water heaters
- 14 BS EN 62395-1 - Electrical resistance trace heating systems for industrial and commercial applications. General and testing requirements
- 15 BS EN ISO 1461 - Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods
- 16 DD IEC/TS 62395-2 - Electrical resistance trace heating systems for industrial and commercial applications. Application guide for system design, installation and maintenance.

D Where reference is made to a British Standard (BS), a British Standard institution (BSI) recognised equivalent European Standard would also apply. Each type of equipment / material selected shall comply with the latest issue of the BS or European Standards.

E The installation shall also comply with the following:

- 1 BBA British Board of Agrément Certificate, where applicable
- 2 Plumbing Engineering Services Design Guide
- 3 Current Building Regulations Approved Documents
- 4 Water Supply (Water Fittings) Regulations
- 5 HSE Legionnaires' disease - The Control of legionella bacteria in water systems (L8).

- F Ensure that the installation, equipment, materials, workmanship, testing and commissioning are in accordance with, and follow the recommendations of the water bylaws.
- G Ensure that all materials are WRAS listed and approved for use in potable water systems.
- H All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 97/23/EC, implemented in the UK through the Pressure Equipment Regulations 1999, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.
- I Check dimensions on site prior to ordering.

S10.1.7 WATER SYSTEM DEAD LEGS

- A Potable Cold water: No dead legs are permitted.
- B Hot Water:
- 1 The hot water, at distribution temperature should arrive within 60 seconds and the maximum dead leg quantity should not exceed that indicated in part 3 of this specification
 - 2 Provide either temperature maintenance tape fixed under the insulation, or secondary circulation loop where the dead legs exceed the maximum criteria indicated in part 3.

S10.2 PART 2 - PRODUCTS

S10.2.1 HWH6 ELECTRIC SMALL CAPACITY (10-50 LITRES) UNVENTED POINT OF USE STORAGE WATER HEATERS

- A Provide electric small capacity water heaters for point of use applications where indicated on the drawings and type as scheduled in section D of this specification.
- B Manufacturers:
 - 1 Heatrae Sadia
 - 2 Santon
 - 3 Zip.
- C Capacity (Litres): 10, 15, 30 or 50 as scheduled
- D Orientation: Horizontal or vertical as scheduled or indicated on the drawings.
- E Electric heating Element: 2.8kW or 4.1kW (230V,50Hz) as scheduled.
- F Construction: Small Capacity unvented Hot water storage calorifiers shall consist of heavy gauge copper type tested to 20 bar or approved equivalent.
 - 1 Outer case: White top and base mouldings with corrosion proof steel centre section finished in white stove enamel.
 - 2 Thermal insulation: CFC free fire – retardant polyurethane foam.
- G Each system shall come complete with an expansion vessel, combined pressure-reducing valve with built in strainer, pressure relief valve, discharge tundish, service valve and wall mounting brackets.
- H The heater shall come complete with a factory fitted temperature and pressure relief valve set to an operate at 7 bar and 90°C. Discharge from temperature and pressure relief valve must be plumbed to discharge in a safe visible manner in accordance with the Building Regulations.

S10.2.2 CONNECTIONS TO SANITARY WARE

- A All basins, baths, bidets and sinks shall be provided with securely fixed taps with the hot tap fixed on the left-hand side and the cold tap on the right hand side when viewed from the front. All connections to have isolating valves on the water supply connections.
- B All appliance taps to discharge above the rim of the appliance with a suitable air gap in accordance with the Water Supply (Water Fittings) Regulations.
- C All water supplies to WCs and urinals to discharge via a flushing cistern with a suitable air gap or a separate flushing valve with integral or separate pipe interrupter.

S10.2.3 WATER HAMMER ARRESTERS

- A Application: Provide water hammer arresters to absorb the noise from possible shock wave pressure surges in hot and cold water distribution mains where quick acting solenoid valves are used, (typically on washing machines, dishwashers or other commercial appliances) or on branches serving quarter turn/ceramic disc taps. Install as close as possible to equipment solenoid valves or at ends of horizontal branches.
- B Suitable manufacturers;
 - 1 Red Dragon Valves
 - 2 Watts Industries
 - 3 Pegler
- C Construction:

- 1 "I" style or inline
- 2 Ends:
 - a 15-65mm: Screwed BSP/NPT
 - b $\geq$ 80mm: Flanged PN16
- 3 Material:
 - a Body: Bronze or Brass
 - b Diaphragm: NBR
- 4 Air chamber
 - a Pressure: 2.5 Bar
 - b Pre-charging valve: Schrader type
- 5 Maximum Operating conditions:
 - a temperature: 85°C
 - b Pressure: 10 bar
- 6 Approvals:
 - a WRAS
 - b CE listed`

S10.3 PART 3 - EXECUTION

S10.3.1 EXAMINATION

- A Examine areas for compliance with requirements for installation tolerances and for structural rigidity, strength, anchors, and other conditions affecting performance of heat exchangers.
- B Proceed with installation only after unsatisfactory conditions have been corrected.
- C Ensure that water supply to hot water generating equipment is fitted with water conditioner or water softening equipment depending upon the degree of water hardness in the locality.

S10.3.2 POINT OF USE ELECTRIC WATER HEATER

- A Install in accordance with manufacturers guidance.

S10.3.3 PIPEWORK ROUTING

- A All cold-water distribution pipework, mains and cistern down-feeds should be located, as far as is practicable, to minimise heat gains from their environment. Pipework should not be routed:
 - 1 through hot ducts
 - 2 run adjacent to heat sources, such as radiators.
- B Where hot and cold-water pipes are run horizontally together, the cold water pipe should be located beneath the hot water pipe to minimise local warming by means of convection.
- C All pipework should be insulated, except for any exposed final connections to sanitary appliances, and should be arranged to eliminate or minimise dead legs.

S10.3.4 WATER SYSTEM DEAD LEGS

- A Potable Cold water: No dead legs are permitted.
 - 1 Do not leave any capped off branches where it is not possible to draw off fresh water.
 - 2 When making provision for future connections install removable spool pieces (valved either side) to permit branch connections to be installed at a future date.
- B Hot Water:
 - 1 For hospital applications no dead legs are permitted.
 - 2 For other projects where the location of hot water outlets require long lengths of pipe (dead legs) to serve them, heat energy is lost in running water to waste until the water discharged is at a suitable temperature.

The hot water, at distribution temperature should arrive within 30 seconds and the maximum dead leg quantity should not exceed 1.5L for primary distribution or 0.5L for secondary distribution (eg from a blending valve) which results in the following maximum lengths:

Table of Maximum Hot Water Pipework Dead legs		
Nominal pipe Bore ID mm	Maximum Length (Primary Distribution) at 60°C	Max Length Secondary distribution (blended water)
mm	m	m
15	10.3	3.4
20	4.7	1.6
25	2.7	0.9

32	1.8	0.6
40	1.2	0.4

- 3 Provide either temperature maintenance tape fixed under the insulation, or secondary circulation loop where the dead legs exceed the maximum criteria indicated above.

S10.3.5 CONNECTIONS

- A All pipework connections to each water heater shall have a union disconnection point between the heater and its stop valve.
- B All drain points, vent and safety valve discharge pipes shall be extended to discharge over a tundish, which shall be piped to the nearest floor drain. Tundish pipework shall be concealed.
- C The contractor shall ensure that all the pipe and electrical connections to each water heater are easily accessible for maintenance and that the heater can be removed and replaced with the minimum of disturbance to the system.
- D No isolating valves shall be installed in a manner that could by intent or inadvertently isolate any safety valves or other safety features installed on the water heater.
- E Maintain manufacturer's recommended clearances for service and maintenance. Install piping connections to allow service and maintenance of equipment.
- F Install shutoff valves at equipment inlet and outlet connections.
- G Install relief valves on heat-exchanger heated-fluid connection and install pipe relief valves, full size of valve connection, to floor drain.
- H Install vacuum breaker at heat-exchanger steam inlet connection.
- I Install hose end valve to drain shell of heat exchangers.

S10.3.6 INSPECTION, TESTING AND STERILISATION

- A All domestic water service pipework shall be visibly examined and tested before being concealed or built into the structure:
 - 1 All pipework and water heaters are to be pressure tested to twice the working head, without loss of pressure for 2 hours. Pressure test to be recorded with a pressure recorder. On satisfactory completion of A (1) all pipes shall be washed out and shall only then be built into the structures prior to final testing
 - 2 The final tests will be as A (1) but shall also include that each draw-off tap and shower fitting meets the approved supplier's specification
 - 3 On satisfactory completion A (2), the system shall be flushed out and refilled with chlorinated water in compliance with section S12.
- B Carry out combustion and heat balance testing of each gas fired water heater boiler, by manufacturer engineers, and issue test report to Engineer. Test in accordance with CIBSE Commissioning Code B.

S10.3.7 FIELD QUALITY CONTROL

- A Test and adjust controls and pressure temperature reliefs and alarms. Replace damaged and malfunctioning controls and equipment.

S10.3.8 DEMONSTRATION

- A Train employer's maintenance personnel to adjust, operate, and maintain heat exchangers, and water treatment plant.

S12 WATER TREATMENT SYSTEMS

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S12.3.5	DEMONSTRATION

S12.1 PART 1 - GENERAL

S12.1.1 RELATED DOCUMENTS

A For drawings and general provisions of the Contract refer to main Contract Preliminaries.

B Related Sections include the following:

1	Y10	Domestic Pipework
2	Y11	Pipeline Ancillaries
3	Y30	Thermal Insulation
4	S10	Hot & Cold Water
5	Y32	Mechanical plant and equipment identification
6	Y41	Building Monitoring and management systems
7	Y50	Mechanical commissioning
8	Y90	fixing to building.

S12.1.2 SUMMARY

A This section includes the provision of a water treatment specialist contractor to carry out the pipework cleaning and system treatment indicated in this section for all domestic water services.

B Domestic water services including hot, cold, potable water and irrigation water services are to be flushed and chlorinated to the standards indicated in this document.

C This section includes the following equipment:

- 1 Biocide chemical-feed equipment and controls
- 2 Chemical treatment test equipment

D Comply with all the utility company requirements regarding water supply.

S12.1.3 DEFINITIONS

A RO: reverse osmosis.

B PVC: polyvinyl chloride plastic.

C TDS: total dissolved solids.

D UV: ultraviolet.

S12.1.4 PERFORMANCE REQUIREMENTS

A Base domestic water treatment on quality of water available at project site.

B Water treatment to achieve:

- 1 Chlorination to requirements of HS(G)274 & BS EN 806-2:2005, BS EN 806-1:2000, BS EN 806-3:2006, BS EN 806-5:2012, BS EN 806-4:2010, BS 8558:2011

S12.1.5 SUBMITTALS

A Product data: Include rated capacities, accessories, fittings, and furnished specialties for each type of equipment indicated:

- 1 Chemical test equipment
- 2 Chemical material safety data sheets

- B Shop drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details for each item of equipment. Include:
- 1 Power, signal, and control wiring.
- C Field quality-control test reports, testing and commissioning data.
- D Method statement for chlorination.
- E Operation and maintenance data: For all equipment.
- F Other informational submittals:
- 1 Water-treatment program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" article above
 - 2 Water analysis: Illustrate water quality available at project site
 - 3 Passivation confirmation report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to architect.

S12.1.6 QUALITY ASSURANCE

- A Comply with requirements of WRAS, HS(G)274, HSE ACOP L8.
- B Ensure that the whole installation complies with the following standards:
- 1 BS 6700 - Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages (Partially Replaced by BS EN 806) see above
 - 2 BS EN 806-1 - Specifications for installations inside buildings conveying water for human consumption
 - 3 BS EN 806-2 - Specifications for installations inside buildings conveying water for human consumption
 - 4 BS EN 806-3 - Specifications for installations inside buildings conveying water for human consumption. Pipe sizing. Simplified method
 - 5 BS EN 806-4 - Specifications for installations inside buildings conveying water for human consumption. Installation
 - 6 BS EN 14743+A1:2007 - Water conditioning equipment inside buildings. Softeners. Requirements for performance, safety and testing.
- C Where reference is made to a British Standard (BS), a British Standard institution (BSI) recognised equivalent European Standard would also apply. Each type of equipment / material selected shall comply with the latest issue of the BS or European Standards.
- D The installation shall also comply with the following:
- 1 BBA British Board of Agrément Certificate, where applicable
 - 2 Plumbing Engineering Services Design Guide
 - 3 Current Building Regulations Approved Documents
 - 4 Water Supply (Water Fittings) Regulations
 - 5 HSE Legionnaires' disease - The Control of legionella bacteria in water systems (L8).
- E Ensure that the installation, equipment, materials, workmanship, testing and commissioning are in accordance with, and follow the recommendations of the water bylaws.
- F Ensure that all materials are WRAS listed and approved for use in potable water systems.
- G All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 97/23/EC, implemented in the UK through the Pressure Equipment Regulations 1999, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.
- H Check dimensions on site prior to ordering.

S12.1.7 ADDITIONAL MATERIALS

- A Scope of maintenance service: Provide chemicals and service program to maintain water conditions required above to inhibit scale formation, and biological growth for domestic water services piping and tanks. Services and chemicals shall be provided for a period of one year from date of substantial completion, and shall include the following:
- 1 Initial water analysis and water-treatment recommendations
 - 2 Cleaning and chlorination of pipework distribution systems
 - 3 Periodic field service and consultation
 - 4 Customer report charts and log sheets
 - 5 Laboratory technical analysis
 - 6 Analyses and reports of all chemical items concerning safety and compliance with government regulations.

S12.2 PART 2 - PRODUCTS

A No products required.

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S12.3 PART 3 – EXECUTION

S12.3.1 WATER ANALYSIS

- A Undertake the following procedures for cleaning and disinfecting the water services pipework and other water services as detailed below. They shall include for all chemicals required, supplementary materials and plant required, suitable pipework connections and fittings to allow dosing/treatment to be undertaken safely and correctly.
- B Employ the services of a Water Treatment Specialist Contractor to carry out the pipework cleaning and system treatment indicated in this section. The Water Treatment Specialist Contractor shall be responsible for the pipework flushing, chlorination, chemical cleaning and water treatment additions. All works shall be carried out in accordance with BSRIA application guide BG 29/2012 and Health and Safety Executive ACOP L8 and the following specification.
- C The Water Treatment Specialist Contractor is responsible for the safe disposal of all flushing and cleaning water/chemicals. Approval to dispose of any waste shall be approved by the local authority. All solutions in excess of 5000 litres shall be neutralised prior to dispatch.
- D Prior to commencing work the water treatment specialist contractor is required to take samples of the incoming site water supply and test the mains for the following:

Constituent	Test Methods	Test Results
pH value at 25°C	BS 1427 clause 5.3	
Electrical conductivity@25°C (micro S/cm)	BS 1427 clause 5.2	
Total dissolved solids (TDS) (ppm)	BS 1427 clause 5.4	
Total suspended solids (TSS) (ppm)	Spectrophotometric method	
Calcium hardness as CaCO ₃ (ppm)	BS 1427 clause 4.2	
Carbonate as CaCO ₃ (ppm)	BS 1427 clause 4.1	
Bicarbonate as CaCO ₃ (ppm)	BS 1427 clause 4.1	
Total alkalinity as CaCO ₃ (ppm)	BS 1427 clause 4.1	
Total iron (ppm)	Spectrophotometric method	
Sodium as Na (ppm)	APHA 3111	
Potassium as K (ppm)	APHA 3111	
Bacteriological analysis		
Total bacteria (colonies/ml)	APHA 9215B	
pseudomonas		
Total coliforms (colonies/100ml)	APHA 9222B	
Faecal coliforms (colonies/100ml)	APHA 9222D	

S12.3.2 PIPEWORK PRE-CLEANING SYSTEMS

- A All systems shall be fully cleaned and flushed out prior to the addition of water treatment.

- B Immediately after hydraulic testing, all water from the systems shall be fully drained away using pumping facilities where necessary with all drain points and dead legs open to remove all dross and dirt.
- C The systems shall then be re-filled and flushed out a minimum of 2 times until the system has been cleaned to the satisfaction of the Engineer. A temporary flushing pump shall be provided for this work, the second time being filled with a hosed water supply make up at high level.
- D After flushing and draining all drain pockets, strainers, dead legs, and control valves shall be checked to ensure that the systems are completely clean and free from dirt before the systems are put into commission.
- E Should the site water supply be inadequate for the water flow required the Contractor shall provide a mobile water tank and pump set of sufficient capacity to achieve the flushing velocities required.
- F Provide a detailed method statement of the proposed flushing procedures prior to commencement, to be agreed with the Engineer.
- G Particular emphasis shall be given to proposals for disposal of water during this process. Care shall be taken to ensure that the minimum flushing velocities indicated in BSRIA BG 29/2012 Pre-Commission Cleaning Water Systems are achieved for particle sizes up to 5mm diameter.
- H Upon completion of the flushing process all utility systems including drinking, cold, hot and firemain systems shall be chlorinated as specified in the following clauses.
- I Ensure all requirements of COSHH regulations are complied with during the chemical cleaning and chemical treatment of the system.
- J Where required by local water authority, provide effluent tanks for storage of all waste products of cleaning and chemical treatment processes. Following local water authority approval, either neutralize and dispose to drain of all waste products; or ensure authorised disposal at registered sites.

S12.3.3 CONNECTIONS

- A Piping installation requirements are specified in Y10 sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B Install piping adjacent to equipment to allow service and maintenance.
- C Make piping connections between water-treatment equipment and dissimilar-metal piping with dielectric fittings.
- D Install shutoff valves on water-treatment equipment inlet and outlet.
- E Refer to Y10 - Y12 for backflow preventers required in makeup water connections to potable-water systems.

S12.3.4 FIELD QUALITY CONTROL

- A Manufacturer's field service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B Perform tests and inspections and prepare test reports:
 - 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.
- C Tests and Inspections:
 - 1 Inspect field-assembled components and equipment installation, including piping and electrical connections
 - 2 Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system

- 3 Place water-treatment system into operation and calibrate controls during the preliminary phase of systems' start up procedures
- 4 Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved
- 5 Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested
- 6 Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved
- 7 Cap and subject piping to static water pressure of 345 kPa above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects
- 8 Repair leaks and defects with new materials and retest piping until no leaks exist.

D Remove and replace malfunctioning units and retest as specified above.

S12.3.5 DEMONSTRATION

A Engage a factory-authorized service representative to train employer's maintenance personnel to adjust, operate, and maintain water-treatment systems and equipment.

U10 VENTILATION SYSTEMS

Contents

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U10.1 PART 1 - GENERAL

U10.1.1 RELATED DOCUMENTS

- A For drawings and general provisions of the contract refer to main contract
- B Refer also to the following sections:
 - 1 U80: Air Ductwork and Ancillaries
 - 2 U82: Fans
 - 3 U88: Air Terminal Devices
 - 4 Y30: Thermal insulation
 - 5 Y32: Mechanical identification
 - 6 Y31: Mechanical vibration control
 - 7 Y50: Testing and commissioning of mechanical and electrical services
 - 8 Y90: Fixing to building fabric

U10.1.2 SUMMARY

- A This section covers the general provisions for the design and supply of ventilation equipment and the cleaning of air distribution systems prior to handover.
- B This section includes the following:
 - 1 Requirements for air distribution system cleaning
 - 2 Requirements for Building air tightness testing
- C Other sections of the specification also cover ventilation systems and note in particular:

U10.1.3 PERFORMANCE REQUIREMENTS

- A Supply, install, clean, test and commission the complete ventilation systems.
- B Ventilation is required to comply with the following where appropriate:
 - 1 Buildings other than dwellings: One of the following methods:
 - a Ventilation rates in Approved document F
 - b Compliance with CIBSE Guide A and B
 - c CIBSE Application Manual AM 13: Mixed mode ventilation
 - d Health care premises: HTM 03-01
- C Performance includes the airflows, water flows, temperatures, pressure drops, noise ratings and electrical consumption.
- D All fan resistances stated have been calculated based on a particular selection of equipment and the design drawings. Recheck, adjust and re-select fan external resistances to suit the final selection of plant and equipment such as grilles and diffusers and the final routing and sizing of the ductwork installations.
- E Similarly, reselect the necessary motor size, wiring and suitable attenuators to achieve the specified noise ratings stated elsewhere. Advise other trade contractors who may be affected by any alterations.
- F Provide results of aerodynamic and acoustic performance tests in accordance with:
 - 1 BS EN 13053: Ventilation for Buildings _ Air handling units-Rating and performance for units, components and sections
 - 2 BS EN ISO 5801: Industrial fans performance testing,
 - 3 BS EN ISO 5136, Acoustics — Determination of sound power radiated into a duct by fans and other air moving devices — In-duct method (ISO 5136:2003)
 - 4 BS ISO 13347-1+A1, BS ISO 13347-2, BS ISO 13347-3+A1, BS ISO 13347-4 Industrial fans. Determination of fan sound power levels.

U10.1.4 DEFINITIONS

A The following acronyms are used in this specification:

- 1 DIL: Dynamic Insertion Loss in dB re 10^{-12} W referring to attenuator performance
- 2 IAQ: Indoor Air Quality
- 3 LEV: Local Exhaust Ventilation an engineered control system to reduce exposures to airborne contaminants such as dust, mist, fume, vapour or gas in the workplace which are classified as Hazardous substances.
- 4 LVHV: Low Volume High Velocity extraction where a small hood is employed with very high face velocity. Often used for hand tools.
- 5 MEV: Mechanical Extract Ventilation comprising a system of ductwork and extract fans used where natural ventilation alone cannot achieve the required air change rate.
- 6 MVHR: Mechanical ventilation and heat recovery
- 7 HVCA: Heating and Ventilating Contractors' Association now replaced by Building and Engineering Services Association (B&ES).
- 8 PDI: Protection, Delivery and Installation standards (ductwork cleanliness).

B The following definitions are used:

- 1 Natural ventilation: relies on wind pressure and temperature differences to move fresh air through a building
- 2 Mechanical ventilation: sometimes referred to as "forced ventilation" uses mechanical supply and/or extract fans to provide fresh air and exhaust stale air.

U10.1.5 SUBMITTALS

A Provide manufacturing drawings of each type of ventilation unit showing configuration and dimensions of the units, with samples of colours, casing materials. Provide the following information for each system:

- 1 Shop Drawings:
 - a Fabrication, assembly and installation, including plans, elevations, sections, components and attachments to other work
 - b Factory- and shop-fabricated ducts and fittings
 - c Duct layout indicating sizes, configuration, liner material, and static-pressure classes
 - d Elevation of top of ducts
 - e Dimensions of main duct runs from building grid lines
 - f Fittings
 - g Reinforcement and spacing
 - h Seam and joint construction
 - i Penetrations through fire-rated and other partitions
 - j Equipment installation based on equipment being used on Project
 - k Locations for duct accessories, including dampers, turning vanes, and access doors and panels
 - l Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- 2 Coordination drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - a Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout
 - b Suspended ceiling components
 - c Structural members to which duct will be attached
 - d Size and location of initial access modules for acoustical tile
 - e Penetrations of smoke barriers and fire-rated construction.
 - f Items penetrating finished ceiling including the following:
 - Lighting fixtures
 - Air outlets and inlets

- Speakers
- Sprinklers
- Access panels
- Perimeter mouldings.

- B Supply and Extract Fan data: Include rated capacities, operating characteristics, sound power and sound pressure levels, furnish
- C Wiring diagrams: Provide power, signal, and control wiring showing interfaces to BMS system and local operator alarms.
- D Field quality-control test reports.
- E Operation and maintenance data: For fans and ducts which should be included in the emergency, operation, and maintenance manuals, as defined in BS EN14175-2:2003, and other information to include:
- 1 Description of main construction parts and materials for the systems
 - 2 Installation instructions
 - 3 Drawings showing the complete final installation
 - 4 General operating and safety instructions
 - 5 Maintenance and cleaning instructions and spare part list
 - 6 Type test report
 - 7 The results of the commissioning tests undertaken by the installer, and any proposed amendments to the purchaser's requirements
- B Provide samples of grilles, diffusers, terminal units and louvres for approval.

U10.1.6 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 will be exposed.
- B Ensure that the whole installation complies with the relevant standards, including but not restricted to, the following:
- 1 BS 476-7: Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products
 - 2 BS 476-20: Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles)
 - 3 BS 1710 - Specification for identification of pipelines and services
 - 4 BS 5422 - Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C
 - 5 BS EN 1886 - Ventilation for buildings. Air handling units. Mechanical performance
 - 6 BS EN 12101 - Smoke and heat control systems
 - 7 BS EN 12097: Ventilation for buildings. Requirements for ductwork components to facilitate maintenance of ductwork systems
 - 8 BS EN 12599 - Ventilation for buildings – test procedures and measuring methods for handling over installed ventilation and air conditioning systems
 - 9 BS EN 12792 - Ventilation for buildings – Symbols, terminology and graphical symbols
 - 10 BS EN 13053 - Ventilation for buildings. Air handling units. Rating and performance for units, components and sections
 - 11 BS EN 16798-3 Energy performance of buildings. Ventilation for buildings. For non-residential buildings. Performance requirements for ventilation and room-conditioning systems (modules M5-1, M5-4)
 - 12 BS EN – ISO 29464 Cleaning of air and other gases. Terminology
 - 13 BS EN 15423 - Ventilation for buildings. Fire precaution for air distribution systems in buildings
 - 14 BS EN 15780 – Ventilation for buildings – Ductwork-Cleanliness of ventilation systems
 - 15 BS EN ISO 5136, Acoustics — Determination of sound power radiated into a duct by fans and other air moving devices — In-duct method (ISO 5136:2003)

- 16 BS EN ISO 5801: Fans. performance testing using standardized airways,
- 17 BS EN ISO 9001 - Quality management systems. Requirements
- 18 BS ISO 13347-1+A1, BS ISO 13347-2, BS ISO 13347-3+A1, BS ISO 13347-4 Industrial fans. Determination of fan sound power levels
- 19 Building Regulations including Non-Domestic Building Services Compliance Guide.
- 20 HSE Approved Code of Practice (ACoP) and Guidance, L8, "Legionnaires disease"

C Ensure that the whole installation also complies with all relevant BESA (HVCA) specifications and codes of practice:

- 1 DW 143: Guide to Good Practice – Ductwork Leakage testing
- 2 DW 144: Specification for Sheet Metal Ductwork
- 3 DW 145: Guide to Good Practice for the Installation of Fire and Smoke Dampers
- 4 DW 154: Specification for Plastics Ductwork
- 5 DW 172: Specification for Kitchen Ventilation Systems
- 6 Withdrawn TR 19: Guide to good Practice- Internal Cleanliness of Ventilation Systems

D Ensure that the whole installation also complies with all relevant CIBSE Guides, application manuals and technical memoranda and codes of practice:

- 1 CIBSE Application Manuals
 - a AM10: Natural Ventilation in Non-Domestic Buildings
 - b AM11: Building Performance modelling
 - c AM13: Mixed Mode Ventilation
- 2 Commissioning Code A: Air Distribution Systems
- 3 CIBSE Guides
 - a A: Environmental Design
 - b B: Heating, Ventilating, Air Conditioning and Refrigeration
 - c L: Sustainability
 - d M: Maintenance Engineering and Management
- 4 Technical Memoranda
 - a TM13: Minimising the Risk of Legionnaires' Disease
 - b TM21: Minimising Pollution at Air Intakes
 - c TM23: Testing Building For Air Leakage
 - d TM26: Hygienic maintenance of office Ventilation Ductwork
 - e TM31: Building Log Book Toolkit
 - f TM40: Health Issues in Building Services
 - g TM44: Inspection of Air Conditioning Systems

E For health Care projects comply with Guidance produced by NHS estates particularly:

- 1 HTM 03-01: Specialised Ventilation for Healthcare premises
- 2 HTM 04-01: The control of Legionella Hygiene, "safe" hot water, cold water and drinking water systems
- 3 HTM 08-01- Acoustics

U10.2 PART 2 – PRODUCTS

U10.2.1 VENTILATION GENERAL

- A Provide for spaces that are mechanically ventilated and/or air conditioned in compliance with the following:
- 1 Fresh air to be provided in each occupied space at a rate in line with CIBSE Guide B
 - 2 For offices comply with the recommendations in the British Council for Offices guide to Best Practice in the Specification of Offices.
 - 3 For Health care premises comply with NHS estates HTMs
- B Ensure ventilation systems provided comply with the current Building Regulations.
- C Ensure that air intakes and exhausts are a minimum of 10m apart and 20m from external sources of pollution, unless shown otherwise on the design drawings.
- D Ensure that all water and HVAC systems are designed to meet the requirements of HSE Approved Code of Practice (ACoP) and Guidance, L8, "Legionnaires disease; the control of legionella bacteria in water systems". Confirmation is needed that no humidification is present (or where utilised it is of the steam humidification type).
- E Ensure access for maintenance. Minimum provision as follows:
- 1 Access for purposes of maintaining equipment:
 - a Allow for equipment withdrawal
 - b Allow for replacement of components.
 - 2 Access for purpose of replacing filters
 - 3 Access for purpose of cleaning ductwork
 - a Provide access in enclosed ceiling voids where necessary.
- F Where natural ventilation is to be employed comply with CIBSE Application Manual AM 10: 'Natural Ventilation in Non-Domestic Buildings' and the current Building Regulations.
- G Where "mixed mode" ventilation is to be employed comply with CIBSE Application Manual AM 13 and the Building Regulations.

U10.2.2 FANS GENERAL

- A Provide fans as detailed in the equipment schedules (Specification Section D) and drawings. Clause references in the schedules refer to U82 and identify the specific fan type, construction and description.
- B Comply with performance details indicated in the equipment schedules Section D of this specification.
- C Comply with Building Regulations, including Non-Domestic Building Services Compliance Guide, requirements with respect to specific fan power.
- D Provide inverter drives for commissioning purposes for all supply and extract fans with motors larger than 1.1kW in compliance with Building Regulations.

U10.2.3 GRILLES AND DIFFUSERS

- A Provide grilles and diffusers as detailed in the equipment schedules (Specification Section D) and drawings. Clause references in the schedules refer to U88 and identify the specific type, construction and description.
- B Comply with performance details indicated in the equipment schedules Section D of this specification.

U10.2.4 LOUVRES

- A Where louvres have an architectural impact, they are to be as detailed by the architect.

- B Where louvers are required to be provided under this subcontract, they will be indicated on the equipment schedules (Specification Section D). Clause references refer to U88 and identify the specific type, construction and description.
- C No louvres may be ordered until approval for the drawings has been obtained from the CA and until the dimensions of the openings into which they are to be fitted have been checked.

U10.3 PART 3 – EXECUTION

U10.3.1 DUCTWORK INSTALLATION

- A For ductwork installation refer to section U80.
- B For ductwork air leakage testing refer to section U80
- C For ductwork cleaning and post installation cleaning verification tests refer to section U80

U10.3.2 FIELD QUALITY CONTROL

- A Perform tests and inspections for ductwork generally as follows. For ductwork installation requirements, including provisions for cleaning and testing refer to section U80.
- B Note all ducts to be air leakage tested.
- C Perform building air tightness tests in accordance with the requirements of the Building Regulations.
- D Prepare test and inspection reports.

U10.3.3 DUCT TESTING, INSPECTION AND CLEANING

- A General requirements:
 - 1 For ductwork leakage testing: refer to U80
 - 2 For ductwork pre-cleaning inspection: refer to U80
 - 3 For ductwork post installation clean: refer to U80
 - 4 For ductwork balancing and commissioning refer to section Y50
- B Builder's work ducts, of masonry or concrete, when used for the transport of air must be surface-sealed to prevent the release of dust before being brought into use.

U10.3.4 CLEANING OF VENTILATION SYSTEM EQUIPMENT COMPONENTS

- A These clauses indicate additional requirements for ventilation equipment which supply, recirculate or extract air from occupied areas. Manufacturer is required to:
 - 1 Completely clean the equipment before delivery
 - 2 Protectively seal the equipment from contamination during transportation
 - 3 Ensure that all components are accessible and able to be cleaned and if necessary disinfected.
 - 4 Materials in contact with the air streams should not absorb moisture or support micro-organisms
- B The contractor is required to:
 - 1 Store and protect the units so that contamination is prevented
 - 2 Preserve the unit protection during the installation and protect from dirt ingress.
 - 3 Inspect and clean units after installation
- C Air Handling units to be cleaned internally as follows: Ensure that all materials used in cleaning are applied in accordance with manufacturer's instructions and in compliance with COSHH regulations.
 - 1 Casing:
 - a Ensure that air leakage does not exceed classification requirements (refer to U81)
 - b Remove filters
 - c Remove any internal rust and the apply an appropriate protective paint
 - d Brush and vacuum clean all internal surfaces

- 2 Coils:
 - a Brush and vacuum clean
 - b Comb and straighten fins
 - c Detergent clean and rinse with pressurised water
- 3 Condensate trays and drain:
 - a Detergent clean
 - b Disinfect using spray or gas.
- 4 Filters:
 - a Remove filters when cleaning AHUs internally
 - b Check filter installation complies with BS EN 13053 and BS EN 13779
 - c Replace filters immediately prior to handover/occupation

U10.3.5 START UP & COMMISSIONING

- A Comply with requirements in Y50 Section 'Testing and Commissioning'.

U80 AIR DUCTWORK AND ANCILLARIES

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U80.1 PART 1 - GENERAL

U80.1.1 RELATED DOCUMENTS

- A For drawings and general provisions of the contract refer to main contract preliminaries.
- B Refer also to the following sections:
 - 1 U10 Ventilation Systems
 - 2 U82 Fans
 - 3 U88 Air Terminal Devices
 - 4 Y30 Mechanical Thermal Insulation
 - 5 Y31 Vibration Isolation Mountings
 - 6 Y32 Mechanical Plant and equipment identification
 - 7 Y50 Testing and commissioning
 - 8 Y90 Fixing to Building fabric.

U80.1.2 SUMMARY

- A This section covers the construction and installation of ductwork and associated components used in the conveyance of air in various air handling systems.
- B Section includes the following galvanised steel ductwork materials:
 - 1 Single-wall rectangular ducts and fittings
 - 2 Single-wall round and flat-oval ducts and fittings
 - 3 Sheet metal materials
 - 4 Sealants and gaskets
 - 5 Hangers and supports.
- C Section also includes ductwork fabricated from other materials:
 - 1 Aluminium ductwork
 - 2 Stainless steel
 - 3 PVC-U
 - 4 polypropylene
 - 5 Resin bonded glass fibre.
- D Section also includes the following ductwork accessories:
 - 1 Backdraft and pressure relief dampers
 - 2 Manual volume dampers
 - 3 Fire dampers
 - 4 Smoke dampers
 - 5 Combination fire and smoke dampers
 - 6 Flange connectors
 - 7 Duct silencers
 - 8 Turning vanes
 - 9 Remote damper operators
 - 10 Duct-mounted access doors
 - 11 Flexible connectors
 - 12 Flexible ducts
 - 13 Duct accessory hardware.

U80.1.3 DEFINITIONS

- A The following acronyms are used in this section

- 1 BESA: Building Engineering Services Association
- 2 PDI: Protection, Delivery and Installation (PDI) quality standard for ductwork protection to minimise cleaning in accordance with TR19 Table F2.

U80.1.4 PERFORMANCE REQUIREMENTS

- A Supply, install, clean, test and commission the complete ductwork systems.
- B Sizes of ductwork are internal dimensions. Where applicable make allowance for any internal lining.
- C Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, is to comply with the recommendations of the BESA as set out in the specification DW/144 and addenda unless otherwise stated. A copy of this document is to be kept on site at all times.
- D Design duct hangers and supports in accordance with DW/144 and the standard details and layout drawings.
- E Airstream surfaces: Surfaces in contact with the airstream to be:
 - 1 Resistant to mould growth
 - 2 Resistant to erosion under the air velocities imposed.
- F Ductwork systems are to achieve the level of cleanliness indicated in section B and U10 of the specification.
- G For manufacture, delivery and protection requirements refer to part 3 of this specification.

U80.1.5 SUBMITTALS

- A Refer to Section A of this specification.
- B Provide the following reports:
 - 1 Leakage Test Report in accordance with BESA specification DW/143 (All ductwork is required to be pressure tested)
 - 2 Field Quality – Control Reports.
- C Shop drawings:
 - 1 Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work
 - 2 Factory- and shop-fabricated ducts and fittings
 - 3 Duct layout indicating sizes, configuration, liner material, and static-pressure classes
 - 4 Elevation of bottom of ducts
 - 5 Dimensions of main duct runs from building grid lines
 - 6 Fittings
 - 7 Reinforcement and spacing
 - 8 Seam and joint construction
 - 9 Penetrations through fire-rated and other partitions
 - 10 Equipment installation based on equipment being used on project
 - 11 Locations for duct accessories, including dampers, turning vanes, and access doors and panels
 - 12 Hangers and supports, including methods for duct and building attachment and vibration isolation.
- D Contractor's design submittal:
 - 1 Sheet metal thicknesses
 - 2 Joint and seam construction and sealing
 - 3 Reinforcement details and spacing
 - 4 Materials, fabrication, assembly, and spacing of hangers and supports
 - 5 Design calculations: Calculations, including analysis data for selecting hangers and supports.

E Co-ordination drawings: 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 Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout
- 2 Suspended ceiling components
- 3 Structural members to which duct will be attached
- 4 Size and location of initial access modules for acoustical tile
- 5 Penetrations of smoke barriers and fire-rated construction
- 6 Items penetrating finished ceiling including the following:
 - a Lighting fixtures
 - b Air outlets and inlets
 - c Speakers
 - d Sprinklers
 - e Access panels
 - f Perimeter mouldings.

U80.1.6 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 will be exposed.

B Ensure that the whole installation complies with the relevant standards, including but not restricted to, the following:

- 1 BS 476-6+A1 - Fire tests on building materials and structures. Method of test for fire propagation for products
- 2 BS 476-7 - Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products
- 3 BS 476-20 - Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles)
- 4 BS 476-23 - Fire tests on building materials and structures. Methods for determination of the contribution of components to the fire resistance of a structure
- 5 BS 476-24, ISO 6944 - Fire tests on building materials and structures. Method for determination of the fire resistance of ventilation ducts
- 6 BS 7671+A1 - Requirements for electrical installations. IEE Wiring Regulations. Eighteenth edition
- 7 BS 9999 - Code of practice for fire safety in the design, management and use of buildings
- 8 BS EN 54-7: Fire detection and fire alarm systems. Smoke detectors. Point detectors using scattered light, transmitted light or ionization
- 9 BS EN 1507 - Ventilation for buildings. Sheet metal air ducts with rectangular section. Requirements for strength and leakage
- 10 BS EN 10088-1 - Stainless steels. List of stainless steels
- 11 BS EN 10346 - Continuously hot-dip coated steel flat products. Technical delivery conditions
- 12 BS EN 12097: Ventilation for buildings. Requirements for ductwork components to facilitate maintenance of ductwork systems
- 13 BS EN 12236 - Ventilation for buildings. Ductwork hangers and supports. Requirements for strength
- 14 BS EN 12237 - Ventilation for buildings. Ductwork. Strength and leakage of circular sheet metal ducts
- 15 BS EN 12599 - Ventilation for buildings – test procedures and measuring methods for handling over installed ventilation and air conditioning systems
- 16 BS EN 12792 - Ventilation for buildings – Symbols, terminology and graphical symbols
- 17 BS EN 13180 - Ventilation for buildings. Ductwork. Dimensions and mechanical requirements for flexible ducts
- 18 BS EN 13501-3+A1- Fire classification of construction products and building elements. Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers

- 19 BS EN 13501-4+A1 - Fire classification of construction products and building elements. Classification using data from fire resistance tests on components of smoke control systems
- 20 BS EN 1366-2 - Fire resistance tests for service installations. Fire dampers
- 21 BS EN ISO 1461 - Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods.
- 22 BS EN 15650: Ventilation for buildings. Fire dampers
- 23 BS EN 15780: Ventilation for buildings. Ductwork. Cleanliness of ventilation systems
- 24 BS EN IEC 60068-2-52: Environmental testing. Tests. Test Kb: Salt mist, cyclic (sodium chloride solution)
- 25 BS ISO 10294-4: +A1: Fire resistance tests. Fire dampers for air distribution systems. Test of thermal release mechanism

C Ensure that the whole installation also complies with all relevant BESA specifications and codes of practice:

- 1 DW 143: A Practical Guide to Ductwork Leakage Testing
- 2 DW 144: Specification for Sheet Metal Ductwork, Low, Medium & High Pressure/Velocity Air Systems
- 3 DW 145: Guide to Good Practice for the Installation of Fire Dampers
- 4 DW 154: Specification for Plastics Ductwork
- 5 DW 172: Specification for Kitchen Ventilation Systems
- 6 TR 19: Guide to Good Practice – Internal Cleanliness of Ventilation Systems.

U80.1.7 CO-ORDINATION

- A Co-ordinate layout and installation of ductwork and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B Co-ordinate size and location of access panels to enable routine maintenance to take place. Warranty.

U80.2 PART 2 – PRODUCTS

U80.2.1 DUCTWORK

- A Provide ductwork, fittings and all associated hangers, supports, dampers, flexible joints sealants, insulation, access, testing and builder's work connections which conform to the recommendations of the BESA as set out in the specification DW/144 and addenda unless otherwise stated
- B Construct ductwork to the structural minimum or higher standard that is compatible with the system operating pressure according to the classification table of DW/144 reproduced here. (Note p is the differential pressure in Pa)

Duct Pressure Class	System Duct Pressure Definition	Static Pressure Limit		Maximum Air Velocity	Air Leakage Limits
		Positive	Negative		
		Pa	Pa	m/s	L/s/m ² of duct surface area
A	Low	500	500	10	$0.027 \times p^{0.65}$
B	Medium	1000	750	20	$0.009 \times p^{0.65}$
C	High	2000	750	40	$0.003 \times p^{0.65}$
D	High	2000	750	40	$0.001 \times p^{0.65}$

- C For industrial and process extract refer to section U24 for ductwork constructional standards which require thicker sheet metal. For fume cabinet and laboratory extract refer to U21.
- D Apply thermal insulation and cladding as required by reference to Y30:
- 1 To limit heat gain into or heat loss from the ductwork
 - 2 In conjunction with a vapour barrier to avoid condensation
 - 3 To protect personnel from contact with surface temperatures greater than 55°C.
 - 1 Apply protective cladding where required in accordance with Y31.

U80.2.2 SHEET METAL DUCTWORK - GALVANISED

- A Use sheet metal ductwork and fittings manufactured in best quality strip mill cold reduced sheet, continuously hot dipped galvanised, zinc coated BS EN 10346 Grade DX51D + Z with an iron-zinc alloy coating type Z275.
- B Use mild steel ductwork only where specifically indicated on the drawings or wherever stated in this specification. Mild steel ductwork and fittings to be manufactured from cold reduced sheet steel to BS EN 10130 Grade FEP01A and hot dipped galvanised to BS EN ISO 1461.
- C Nominal sheet thicknesses are not to be less than 0.6mm indoors and not less than 1.2mm outdoors.
- D Ensure that ductwork, gaskets, flexible joints, acoustic linings and sealants do not support bacterial growth and do not present fire or smoke hazards.

U80.2.3 RECTANGULAR DUCTWORK – GALVANISED

- A Rectangular ductwork and fittings to be constructed using sheet metal as specified above. Select seam types, cross joints and stiffeners and fabricate ductwork according to DW/144.
- B Low pressure ductwork construction:
- 1 Low pressure classification constraints:

	Low pressure (A)
Maximum static pressure - positive	+500 Pa
Minimum static pressure - negative	-500 Pa
Maximum mean air velocity	10 m/s

- 2 The following table indicates acceptable minimum acceptable standards of construction for low pressure ductwork. (Fig nos refer to DW/144).

Longest Side of Duct mm	Metal Thickness mm	Type of Cross Joint & stiffeners	DW 144 Fig Nos.	Joint/stiffening max spacing mm	Joint Flange Angle Size mm	Stiffener Flange Angle Size mm
up to 200	0.6	Socket & Spigot Plain	Fig 20	3000	-	-
201- 400	0.6	Socket & Spigot Plain	Fig 20	3000	-	-
401-600	0.6	Socket & Spigot Angle reinforced	Fig 22	2000	-	25x3
601-800	0.8	Socket & Spigot Angle reinforced	Fig 22	1600	-	30x4
801-1000	0.8	Socket & Spigot Back to back stiffeners	Fig 23	1250	-	30x4
1001-1250	0.8	RS angle Flanged	Fig 13 & 25	1000	25x3	30x3
1250-1600	1.0	RS angle Flanged	Fig 13& 25	800	30x4	40x4
1601-2500	1.0	RS angle Flanged	Fig 13& 25	800	40x4	50x5
2501-3000	1.2	RS angle Flanged	Fig 13& 25	800	50x5	60x5

C Medium pressure ductwork construction:

- 1 Medium pressure classification constraints:

	Medium pressure (B)
Maximum static pressure - positive	+1000 Pa
Minimum static pressure - negative	-750 Pa
Maximum mean air velocity	20 m/s

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- 2 The following table indicates the minimum acceptable standard of construction for medium pressure ductwork. (Fig nos refer to DW144)

Longest Side of Duct mm	Metal Thickness mm	Type of Cross Joint & stiffeners	DW 144 Fig Nos.	Joint/stiffening max spacings mm	Joint Flange Angle Size mm	Stiffener Flange Angle Size mm
up to 400	0.6	Socket & Spigot plain	Fig 20	3000	-	-
401-600	0.6	Socket & Spigot Back to back stiffeners	Fig 23	1600	-	30x4
601-800	0.8	Socket & Spigot Back to back stiffeners	Fig 23	1250	-	30x4
801-1000	0.8	RS angle Flanged	Fig 13& 25	1000	25x25x3	30x4
1001-1250	0.8	RS angle Flanged	Fig 13& 25	800	30x30x4	40x4
1250-1600	1.0	RS angle Flanged	Fig 13& 25	800	40x40x4	50x5
1601-2500	1.0	RS angle Flanged	Fig 13& 25	800	50x50x5	60x5
2501-3000	1.2	RS angle Flanged	Fig 13& 25	625	50x50x5	60x5

D High pressure ductwork construction:

- 1 High pressure classification constraints:

	High pressure (C)	High pressure (D)
Maximum static pressure - positive	+2000 Pa	+2500 Pa
Minimum static pressure - negative	-750 Pa	-750 Pa
Maximum mean air velocity	40 m/s	40 m/s

- 2 The following table indicates the minimum acceptable standard of construction for high velocity ductwork (Fig nos refer to DW144).

Longest Side of Duct mm	Metal Thickness mm	Type of Cross Joint & stiffeners	DW /144 Fig No.	Joint/stiffening max spacings mm	Joint Flange Angle Size mm	Stiffener Flange Angle Size mm
up to 400	0.8	Socket &	Fig 20	3000	-	-

Longest Side of Duct mm	Metal Thickness mm	Type of Cross Joint & stiffeners	DW /144 Fig No.	Joint/stiffening max spacings mm	Joint Flange Angle Size mm	Stiffener Flange Angle Size mm
		Spigot				
401-600	0.8	RS angle Flanged	Fig 13& 25	625	25x25x3	30x4
601-800	0.8	RS angle Flanged	Fig 13& 25	800	25x25x3	30x4
801-1000	0.8	RS angle Flanged	Fig 13& 25	800	25x25x3	30x4
1001-1250	1.0	RS angle Flanged	Fig 13& 25	800	30x30x4	40x4
1250-1600	1.0	RS angle Flanged	Fig 13& 25	800	40x40x4	50x5
1601-2000	1.2	RS angle Flanged	Fig 13& 25	625	40x40x4	50x5
2001-2500	1.2	RS angle Flanged	Fig 13& 25	625	50x50x5	60x5

- E Transverse (cross) joints: Select joint types and fabricate according to BESA DW/144 Figs 13-24
- F Longitudinal seams: Select seam types and fabricate according to BESA DW/144 Figs 4-11.
- G For stiffeners comply with DW/144 Fig nos 25-30 where indicated in tables above.
- H Elbows, transitions, offsets, branch connections, and other duct construction: Select types and fabricate according to BESA DW/144.
- I Insert a pressure applied sealant of the non-hard setting mastic type in every joint prior to assembly, including all lockform joints. It is permissible to use chemical reaction tape or heat shrink strip as alternative methods of sealing provided close contact is maintained over the whole perimeter of the joint.
- J Fastenings to be at a minimum of 60mm centres for sheet to sheet joints and at 150mm centres on all stiffenings, flanges and cross joints.
- K On flanges, joints, etc., mild steel nuts and bolts electro-plated sheradized, or cadmium plated to be used. Other fastenings to be of the mechanically closed rivet type (not pop type or open rivet) which do not protrude into the air space other than the rivet head.

U80.2.4 CIRCULAR DUCTWORK - SPIRALLY WOUND (GALVANISED)

- A Circular ductwork may be of the spirally wound type or straight seamed. Usually ductwork will be of the spirally wound type but use straight seamed ductwork if indicated on the drawings. Fabricate in accordance with DW/144.
- B Spirally wound ductwork and fittings to be constructed from sheet steel as specified elsewhere and to have the following thicknesses and where required, stiffening requirements and flanges of the stated sizes, DW/144 Figs 80-83. The following table applies to all pressure classifications.

Nominal diameter (mm)	Sheet thickness (mm)	Stiffening Type	Stiffening or angle flange sizes (mm)
Up to 200	0.6	None	None
Over 200 and up to 800	0.8	None	None
Over 800 and up to 1000	1.0	Angle reinforced or angle flanged	30 × 30 × 3 @ 3000 centres maximum Figs 80-83
Over 1000 and up to 1500	1.0	Angle flanged	40 × 40 × 4 @ 3000 centres maximum Figs 81-83

- C Cross joints - comply with DW/144 fig nos 87-90 using sealant.
- D Fastenings: Minimum of 60mm centres for sheet to sheet joints and at 150mm centres on all stiffenings, flanges and cross joints.
- E On flanges, joints, etc., mild steel nuts and bolts electro-plated sheradized, or cadmium plated to be used. Other fastenings to be of the mechanically closed rivet type (not pop type or open rivet) which do not protrude into the air space other than the rivet head.
- F Fittings to be in accordance with DW/144.

U80.2.5 CIRCULAR DUCTWORK – STRAIGHT SEAM (GALVANISED)

- A Straight seamed circular ductwork must be used if indicated on the drawings. Typically, this is used where ductwork is exposed to view and a smooth painted finish is required. Fabricate in accordance with DW/144.
- B Straight seam ductwork and fittings to be constructed from sheet steel as specified elsewhere and to have the following thicknesses, stiffening requirements and where required flanges of the stated sizes (fig nos refer to DW/144). The following applies to all pressure classifications

Nominal diameter (mm)	Sheet thickness (mm) Low & Med & High Pressure	Stiffening Type	Stiffening or angle flange sizes (mm)
Up to 200	0.6	None	
Over 200 to 500	0.8	swaged at spigot end	Figs 84&85
Over 500 to 800	0.8	swaged at socket and spigot ends,	Figs 84&85
Over 800 to 1000	1.0	angle rings flanged	25x25x3 – (800Ø) 30x30x4 - (900-1000Ø) @ 1500 centres max Figs 87-90
Over 1000 to 1500	1.2	angle rings flanged	40x40x4 @ 1500 centres Figs 87-90

- G The longitudinal seam for straight seamed circular ducts to be in accordance with DW/144 Fig no 76 grooved seam with sealant. Welded joints are not permitted unless specifically authorised.
- H Cross joints - comply with DW/144 fig nos 87-90 using sealant.
- I Fastenings: Minimum of 60mm centres for sheet to sheet joints and at 150mm centres on all stiffenings, flanges and cross joints.
- J On flanges, joints, etc., mild steel nuts and bolts electro-plated sheradized, or cadmium plated to be used. Other fastenings to be of the mechanically closed rivet type (not pop type or open rivet) which do not protrude into the air space other than the rivet head.
- K Fittings to be in accordance with DW/144.

U80.2.6 FLEXIBLE DUCTWORK

- A Provide flexible ducting for connections between and where indicated on the drawings:
 - 1 Ductwork and grilles/diffusers
 - 2 Ductwork and plenum boxes
 - 3 Fan coil units/CV/ VAV boxes and grilles.
- B Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers or approved equivalent:
 - 1 Flexible Ducting Ltd
 - 2 Hotchkiss.
- C Non-insulated, Flexible Duct: BS 476 parts, 6, 7 & 20 with fire resistance 60 minutes, aluminium laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire:
 - 1 Pressure Rating: 2500 Pa positive and 250 Pa negative
 - 2 Maximum Air Velocity: 20 m/s
 - 3 Temperature Range: -30 to +140°C.
- D Insulated, flexible duct: BS 476 parts, 6,7, & 20 with fire resistance 20-27minutes, aluminium laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; 25mm high density fibrous-glass insulation; aluminized polyester laminate vapour-barrier film:
 - 1 Pressure rating: 2500 Pa positive and 250 Pa negative
 - 2 Maximum air velocity: 20 m/s
 - 3 Temperature range: -30 to + 125 °C.
- E Ensure that flexible ducts are suitable for an operating temperature range of -18°C to 120°C and comply with BS 476-1 withdrawn Section 2 Clause 7 (Class 1: Surface of very low flame spread).
- F Flexible duct connectors:
 - 1 Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, to suit duct size
 - 2 Finally sealed with 100mm wide fire-resistant adhesive tape.
- G Ensure that flexible ductwork does not become kinked or flattened. Changes of direction to be long radius and no kinking or flattening of ducting will be allowed.
- H Do not exceed 600mm long maximum. Support all ducting adequately supported to prevent oscillation and noise generation. Steel wire helical reinforcement in flexible ducts is to be carried over the spigots of grilles and diffusers and connections to these items are to be painted matt black for the visible depth.
- I Use flexible ducting of the insulated type with vapour barrier for all supply & return air ductwork and uninsulated type for extract air ductwork.
- J The joints of rigid spigots to be sealed with a brush coat of pipe jointing paste or mastic compound.

- K The frictional resistance to airflow per unit length of the flexible duct must not exceed 50% more than the frictional resistance per unit length of galvanised steel ducts of equivalent diameter. The radius ratio R/D for bends must not be less than 2, where R is the centre line radius and D is the diameter of the flexible duct.
- L Ensure that flexible ductwork does not pass through fire / smoke resistant building construction nor is it to be used at extract points where deposits of flammable substances are likely to occur in high fire risk areas.
- M The leakage from any section of flexible duct must not exceed 1% of the design airflow rate at the static operating pressure.

U80.2.7 FLEXIBLE CONNECTORS

- A Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 3 Isolated Systems ISL.
- B Flexible connections fitted to the suction and delivery of fans, air handling units and the like and across building expansion joints must conform to BS 476 Part 7 Class 1 and BS 476 Parts 20, 21, 22, 23 and 24.
- C Coatings and adhesives: Comply with UL 181, Class 1.
- D The material used for flexible joints must withstand the specified conditions of temperature, noise attenuation and air pressure. The material should be fire resistant and should comply with the local authority regulations.
- E Comply with requirements of DW/144. On all circular spigots the flexible material is to be secured by a clip band with adjustable screw or toggle fittings. On rectangular connections, the material to be held in place by a mating flange with a backing plate. No flexible joint to allow less than 50mm separation between rigid components and must not exceed 100mm in length.
- F The material is to be fitted to give a tightly clamped joint with no air gaps, the connection remaining flexible without strain and distortion, and must be correctly aligned.
- G The material to have a sound reduction index of at least 20 dB at 500 Hz and 10 dB at 63 Hz and to have an air leakage rate not greater than 0.05 l/s per m² at a static pressure.

U80.2.8 DUCT LINING

- A Ductwork is not to be internally lined because of the risks of fibre or material erosion, microbiological contamination and dirt absorbency which pose unacceptable health risks.

U80.2.9 SEALANTS GASKETS AND TAPES

- A Ductwork sealants: Use non-hardsetting mastic type which retain its adhesion and elasticity throughout a temperature range of 0°C to 70°C. Apply sealant to all joints by pressure using an injection gun or placed into the joint prior to construction such that the sealant is under pressure on erection of the joint. Comply with DW/144.
- B Gaskets for flanged / angle joints: Use the compressible non-hardsetting fibrous mastic type at least 4mm thick when finally installed. The gasket to be continuous over the whole face of the two flanges or angle joints.
- C Heat shrink tape joints: Use continuous band 100mm wide thermoplastic type coated on the inside with adhesive. The band shrinks onto both ends of the joint when heat is applied and forms a tight rigid fix. Do not use heat shrink type joints on flat oval sheet metal ductwork.
- D General sealant and gasket requirements:
 - 1 Surface-burning characteristics for sealants and gaskets:
 - a Test certification: according to UL 723; certified by an local certified testing laboratory.

- b maximum flame-spread index: 25
- c maximum smoke-developed index: 50

E Two-part tape sealing system:

- 1 Tape: Woven cotton fibre impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal
 - a Tape Width: 76 mm
 - a Sealant: Modified styrene acrylic
 - b Water resistant
 - c Mould and mildew resistant
 - d Maximum Static-Pressure Class: 2500 Pa, positive and negative
 - e Service: Indoor and outdoor
 - f Service temperature: Minus 40 to plus 93 °C
 - g Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminium
- 2 For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F Water-based joint and seam sealant:

- 1 Application method: Brush on
- 2 Solids content: Minimum 65 percent
- 3 Shore A hardness: Minimum 20
- 4 Water resistant
- 5 Mould and mildew resistant
- 6 VOC: Maximum 75 g/L (less water)
- 7 Maximum Static-Pressure Class: 2500 Pa, positive and negative
- 8 Service: Indoor or outdoor
- 9 Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminium sheets.

G Solvent-based joint and seam sealant:

- 1 Application method: Brush on
- 2 Base: Synthetic rubber resin
- 3 Solvent: Toluene and heptane
- 4 Solids content: Minimum 60 percent
- 5 Shore A hardness: Minimum 60
- 6 Water resistant
- 7 Mould and mildew resistant
- 8 For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)
- 9 Maximum static-pressure class: 2500 Pa, positive or negative
- 10 Service: Indoor or outdoor
- 11 Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminium sheets.

H Flanged joint sealant: Comply with BESA DW/144.

I Flange gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

U80.2.10 HANGERS AND SUPPORTS

- A Comply with BESA specification DW/144 or 154 and provide supports as indicated on the drawings. Ensure that the maximum intervals listed below are not exceeded.

1 Rectangular (Galvanised MS)

Longest duct side (mm)	Maximum spacing (m)	
	Horizontal	Vertical
Up to 600	3.0	4.0
650 – 900	2.5	3.5
1000 – 1400	2.5	3.5
1500 – 1900	2.5	3.0
2000 and above	2.5	2.5

2 Circular (galvanised MS)

Diameter (mm)	Maximum spacing (m)			
	Straight seam		Spirally wound	
	Horizontal	Vertical	Horizontal	Vertical
Up to 315	1.8	2.8	3.0	3.0
355 to 1250	2.5	3.5	3.0	3.5
1250 and above	2.5	3.5	2.5	3.5

3 Flat oval (galvanised MS).

Major axis (mm)	Maximum Spacing (m)	
	Horizontal	Vertical
400	2.5	3.8
605	2.5	3.8
1000	2.5	3.8
1510	2.0	3.8
2000	2.0	3.8

B Plastic ductwork (PVC-U and PP) and resin bonded mineral fibre.

Duct width or diameter (mm)	Maximum Spacing (m)			
	Circular		Rectangular	
	Horizontal	Vertical	Horizontal	Vertical
up to 450	2.0	2.5	2.0	2.5
451 – 800	2.0	2.3	2.0	2.3
801 – 1200	1.9	2.3	1.9	2.3

C Steel cables are not to be used.

D Duct attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

- E Trapeze and riser supports:
- 1 Supports for galvanized-steel ducts: Galvanized-steel shapes and plates
 - 2 Supports for stainless-steel ducts: Stainless-steel shapes and plates
 - 3 Supports for aluminium ducts: Aluminium or galvanized steel coated with zinc chromate.

U80.2.11 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A Description: Gravity balanced:
- 4 Maximum air velocity: 10 m/s
 - 1 Maximum system pressure 0.5 kPa
 - 2 Frame: 1.6mm thick extruded aluminium or 1.3mm thick stainless steel, with welded corners and mounting flange
 - 3 Blades: Multiple single-piece blades, centre-pivoted, maximum 150mm width, 0.6mm thick, roll-formed aluminium with sealed edges
 - 4 Blade action: Parallel
 - 5 Blade seals: Extruded vinyl mechanically locked
 - 6 Blade Axles: Stainless steel or Aluminium
 - 7 Tie bars and brackets: Aluminium
 - 8 Return spring: Adjustable tension
 - 9 Bearings: Synthetic pivot bushings.
- B Accessories:
- 1 Adjustment device to permit setting for varying differential static pressure
 - 2 Counterweights and spring-assist kits for vertical airflow installations
 - 3 Electric actuators
 - 4 Chain pulls
 - 5 Screen mounting: Front mounted in sleeve
 - 6 Screen material: Galvanized steel
 - 7 Screen type: Bird
 - 8 90-degree stops.

U80.2.12 MANUAL VOLUME DAMPERS

- A For steel ducts provide low leakage manual volume control dampers as follows:
- 1 Low-leakage rating, with linkage outside airstream and Certified for both air performance and air leakage (BS EN 1751)
 - 2 Suitable for horizontal or vertical applications
 - 3 Frames:
 - a Hat-shaped, galvanized-steel channels, 1.62-mm minimum thickness
 - b Mitred and welded corners
 - c Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 4 Blades:
 - a Opposed-blade design
 - b Aerofoil type stainless steel 1.62 mm thick
 - c Maximum width 75mm.
 - 5 Blade axles: Stainless steel
 - 6 Blade seals: Neoprene
 - 7 Jamb seals: Cambered stainless steel
 - 8 Bearings:
 - a Oil-impregnated bronze or moulded synthetic
 - b Dampers in ducts with pressure classes of 750 Pa or less to have axles full length of damper blades and bearings at both ends of operating shaft.

- 9 Damper blades to be a maximum length of 1200mm and where dampers are required in large ducts or large louvres, etc., a galvanised steel channel frame connecting strips to be provided to house banks of individual dampers
 - 10 Where automatic operation is required a geared drive spindle is to be provided, in lieu of the control box and handwheel, to suit the motor driven link or spring assembly control unit
 - 11 Tie bars and brackets: Galvanized steel. Accessories:
 - a Include locking device to hold single-blade dampers in a fixed position without vibration.
- B For aluminium ducts provide low leakage manual volume dampers as follows:
- 1 Low-leakage rating, with linkage outside airstream and certified for both air performance and air leakage
 - 2 Suitable for horizontal or vertical applications
 - 3 Frames: Hat-shaped, 2.5-mm thick, aluminium sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts
 - 4 Blades:
 - a Opposed-blade design
 - b Stiffen damper blades for stability
 - c Retain one of first two subparagraphs below
 - d Roll-formed aluminium blades 2.5-mm thick aluminium sheet
 - e Extruded-aluminium blades: 1.2-mm thick extruded aluminium.
 - 5 Blade axles: Stainless steel
 - 6 Blade seals: Neoprene
 - 7 Jamb seals: Cambered aluminium
 - 8 Bearings:
 - a Oil-impregnated bronze or moulded synthetic
 - b Dampers in ducts with pressure classes of 750 Pa or less to have axles full length of damper blades and bearings at both ends of operating shaft.
 - 9 Tie bars and brackets: Aluminium
 - 10 Accessories:
 - a Include locking device to hold single-blade dampers in a fixed position without vibration.
- C Damper hardware:
- 1 Zinc-plated, die-cast core with dial and handle made of 30-mm thick zinc-plated steel, and a 19-mm hexagon locking nut
 - 2 Include centre hole to suit damper operating-rod size
 - 3 Include elevated platform for insulated duct mounting.
- D Provide an inspection door adjacent to each multi-leaf damper.

U80.2.13 CIRCULAR DUCTWORK DAMPERS

- A Circular ductwork dampers: For ducts less than 800Ømm use Iris type dampers:
- 1 Multi-plate circular shutter
 - 2 Constructed in galvanised sheet steel
 - 3 Lockable controller lever, control scale
 - 4 Pressure differential measuring connections located either side of the shutter blades.
- B Circular ducts dampers: For ducts greater than 800Ømm use multi-leaf opposed blade type as specified elsewhere with circular spigot flange connections to suit the size of adjoining ductwork.

U80.2.14 DAMPERS ON SUPPLY AND EXTRACT TERMINALS

- A All supply grilles and diffusers except those on supplies from fan coils and VAV boxes to be fitted with integral balancing dampers. These dampers should be used for fine trimming only and upstream dampers will provide the main point of balancing.
- B All return air grilles except those connecting to a return air ceiling void plenum or direct to fan coil units to be fitted with integral balancing dampers.
- C Balancing dampers at terminals to be of the opposed blade multi-leaf type designed to give close control of airflow evenly across the face of the terminal with minimum noise generation.

U80.2.15 PRESSURE CONTROL DAMPERS

- A Provide pressure control flaps where it is necessary to maintain positive or negative pressures in spaces such as operating theatre suites, clean rooms and the like.
- B Refer to equipment schedules section D for damper schedule and operating conditions.
- C Pressure control flaps to be of an approved proprietary manufacture. They are to comprise a stainless steel flap and adjustable balance weight assembly contained in a stainless steel casing suitable for wall mounting. The balance weight assembly is to be set at the control pressure.

U80.2.16 SELF-CLOSING (NON-RETURN) DAMPERS

- A Self-closing dampers to be of proprietary manufacture, present a minimum resistance to airflow under running conditions and take up a stable position in operation. Maximum resistance to be present under reverse flow conditions. Resilient strips or other purpose made devices to be provided as an aid to air sealing under reverse flow conditions and to prevent rattling.

U80.2.17 FIRE DAMPERS

- A Where ducts pass through walls, ceilings or floors which are fire compartment barriers, provide fire dampers (denoted FD on drawings) with built in frames. Suitable manufacturers must be ISO 9001 accredited. Fire Dampers to be suitable for providing up to 4 hours fire protection. Suitable manufacturers:
 - 1 Actionair (Swegon)
- B All fire dampers to be CE marked in accordance with the Construction Products Regulations and comply with the following standards:
 - 1 CE marked: BS EN 15650: Ventilation for Buildings – Fire Dampers
 - 2 BS 9999
- C The proposed installation method must be in accordance with the manufacturer's approved details, supported by a valid test report or assessment provided by an approved third party "notified body" and acceptable to the local authority. The installation method must be included on the ductwork installation drawings.
 - 1 Testing: Performance verified through a "Notified Body"
 - a Fire tests: BS EN 1366-2
 - b Classification BS EN 13501-3+A1: E120 (Ho Ve i <->o)
 - c Corrosion testing: BS EN IEC 60068-2-52
 - d Thermal fuse: BS ISO 10294-4+A1
 - e Factory cyclic and leakage testing
 - f LPCB Type approved
 - 2 Air leakage: Comply with DW/144 standards

- D Different fully tested installation methods to be provided for vertical and horizontal fixing. Refer to manufacturer's details for following installation methods all CE marked and approved:
- 1 Installation in solid masonry and concrete walls
 - a Installation frame for vertical mounting
 - 2 Installation in solid masonry and concrete floors
 - a Installation frame for horizontal mounting
 - 3 Dry wall fixing
 - a Dry Wall fix cleats
 - b Dry wall flange and cleats
- E Method of Operation: Damper to be held open by means of a thermally Actuated Device (helical memory compression spring) set to operate at approximately $72^{\circ}\text{C} \pm 4^{\circ}\text{C}$ contained within a cassette mechanism. The spring expands when heated and causes the damper blades to release. On cooling the spring reverts to closed coil state and blades can be manually reset. Where other operational temperatures are required provide, if approved by Building Control, a fusible chain-link mechanism suitable for the operating temperatures.
- F Resetting: Dampers to be provided with single-handed rest self-latching removable release mechanism cassette
- G Construction:
- 1 Casing: 1.2mm Galvanised, fully welded with spigot suitable for rectangular, circular or flat oval connections. When located in stainless steel ductwork the damper casings are to match the specification of the ductwork.
 - 2 Blades: Type 1.4016 (403) Ferritic Stainless-steel folding blade curtain with blades outside of the airstream
 - 3 Springs: Constant tension stainless steel to close and latch damper
 - 4 Actuator: memory coil spring: Cu-Zn-Al brass alloy
 - 5 Cassette:
 - a Fully removable
 - b Hand resettable
 - c Material: Polyphenylene sulphide (PPS) resin reinforced with 40% glass (GF-PPS)
 - 6 External visual blade position indication: Fluorescent red display
- H A 24V AC micro switch (single or double pole) device is to be fitted to allow damper open / closed status to be monitored.
- I The fire dampers to be as manufactured by Actionair (Swegon), Fire / Shield type or approved equivalent up to a maximum size of 1000x1000mm
- 1 Series 201 - Square / Rectangular
 - 2 Series 301 - Circular
 - 3 Series 401 - Flat Oval.
- J Where specified in the BMS system specification provide for 24V electromagnet release and/ or factory fitted micro switches to provide remote electrical indication of damper status.
- K Dimensions:
- 1 Series 201: Rectangular
 - a Minimum: 250 x 100mm
 - b Maximum 1000x1250mm
 - 2 Series 301: Circular
 - a Minimum: 100mm diameter
 - b Maximum: 1000mm diameter
 - 3 Series 401: Flat oval
 - a Minimum: 100 x 300mm

b Maximum: 500 x 1250mm

L For larger sizes:

- 1 If necessary, the dampers may be combined into multiple module arrangements subject to providing manufacturer's minimum masonry/concrete/dry wall construction between the dampers/installation frames.
- 2 Use Combination Fire and Smoke dampers with electric fail safe actuator maximum size 1500 x1500

U80.2.18 COMBINATION FIRE AND SMOKE DAMPERS

A These dampers may be used in addition or instead of fire dampers in fire/smoke compartment walls and floors. They are denoted FSD on the drawings and are used when it is necessary to automatically close the dampers to control smoke or protect escape routes. They are complete with a fail-safe electrical thermal release. Suitable manufacturers:

- 1 Actionair (Swegon): for sizes up to 1000x1000
- 2 Motorised Air Products (Bevent Rasch): for sizes up to 1500 x 1500

B All fire dampers to be CE marked in accordance with the Construction Products Regulations and comply with the following standards:

- 1 CE marked: BS EN 15650: Ventilation for Buildings – Fire Dampers
- 2 BS 9999

C The proposed installation method must be in accordance with the manufacturer's approved details, supported by a valid test report or assessment provided by an approved third party "notified body" and acceptable to the local authority. The installation method must be included on the ductwork installation drawings.

- 2 Testing: Performance verified through a "Notified Body"
 - a Fire tests: BS EN 1366-2
 - b Classification BS EN 13501-3: E120 (Ho Ve i <->o) S20,000
 - c Corrosion testing: BS EN IEC 60068-2-52
 - d Electrical Thermal Release: BS ISO 10294-4+A1
 - e Factory cyclic and leakage testing
 - f LPCB Type approved
- 2 Air leakage: Comply with DW/144 standards
- 3 Control modes: Select control mode to suit performance required and as indicated on the drawings
 - a 24V (Open/Fail safe close)
 - b 24 V (Open/Control/Fail-safe close): in this mode the actuator can open to a set position controlled by 2-10V signal
 - c 230V (Open/Fail-safe close)
- 4 Air Velocity and pressure constraints:
 - a Maximum velocity:15 m/s
 - b Maximum system pressure: 1500 Pa

D Different fully tested installation methods to be provided for vertical and horizontal fixing. Refer to manufacturer's details for following installation methods all CE marked and approved:

- 1 Installation in solid masonry and concrete walls
 - a Installation frame for vertical mounting
 - b Sleeve and angle fixing flanges and cleats
- 2 Installation in solid masonry and concrete floors
 - a Installation frame for horizontal mounting
 - b Sleeve and angle fixing
- 3 Dry wall fixing
 - a Dry Wall fix cleats

- b Dry wall flange and cleats
 - c Dry Wall sleeve and angle
- E Method of Operation: Smoke detector located in the ductwork adjacent to the damper are monitored. The actuator motors the damper to the rest position whilst simultaneously tensioning the spring return. If the power supply is interrupted the damper is released to give fail safe operation. The Electro Thermal Release (ETR) is set to operate at approximately $72^{\circ}\text{C} \pm 4^{\circ}\text{C}$ contained within a cassette mechanism. The ETR housing features:
 - 1 LEDs for indication of:
 - a Unit receiving Power
 - b ETR correctly fitted
 - c Thermal fuse intact.
 - 2 End switches for monitoring damper position
 - 3 Manual operation
 - 4 Test switch
- F Construction:
 - 1 Casing: 1.2mm double skin Galvanised, fully welded with spigot suitable for rectangular, circular or flat oval connections. When located in stainless steel ductwork the damper casings are to match the specification of the ductwork.
 - 2 Blades: Aerodynamic double skin opposed blade construction. Type 1.4016 (403) Ferritic Stainless steel 75mm x 0.5mm interlocking blades with end bearings and peripheral gasketing.
 - 3 Actuators: Unless indicated otherwise on the drawings the dampers are to be fitted with a 230V motor activated by a signal from the fire alarm system or other control system via a suitable input/output unit. Power supply to be taken from a power supply control unit provided by the manufacturer
 - 4 Provide a terminal block adjacent to the damper to permit control of multiple dampers and/or items of equipment such as fans. The damper to be arranged for 60 seconds drive to open position with a 20 second spring return time. On loss of power the damper is to move to the failsafe "closed" position.
 - 5 Smoke detector: BS EN 54-7
- G Where indicated on the drawings and schedules the dampers may alternatively be supplied with 24 V motors.
- H Manufacturer: The combination fire and smoke dampers to be as manufactured by the following or approved equivalent:
 - 1 Actionair Ltd their Smoke / Shield PTC type,
 - a Series 501 and 1501 Square / Rectangular
 - b Series 601 and 1601 Circular
 - c Series 701 and 1701 Flat Oval.
 - 2 MAP
 - a Rectangular type RABR
 - b Circular type RABC
- I Dimensions:
 - 1 Series 501: Rectangular
 - a Minimum: 100 x 100mm
 - b Maximum 1000x1000mm
 - 2 Series 301: Circular
 - a Minimum: 100mm diameter
 - b Maximum: 1000mm diameter
 - 3 Series 401: Flat oval
 - a Minimum: 200 x 300mm
 - b Maximum: 500 x 1000mm
 - 4 RABR: Rectangular

- a Minimum: 200 x 200mm
 - b Maximum 1500x1500mm
- 5 RABC: Circular
 - a Minimum: 100mm diameter
 - b Maximum: 630 mm diameter

U80.2.19 COMBINED FIRE AND SMOKE CONTROL AND VOLUME CONTROL DAMPERS

- A These dampers are to be located as indicated on the drawings and are used when it is necessary to set the dampers at an intermediate position to give balancing control for normal operation. They are denoted FSD/VCD on the drawings.
- B These dampers to be as described for Combined Fire and Smoke Control dampers but with a 3-position control mode to allow the damper to move to a 3rd control position. This mode is provided by a 2-10V DC signal defining the position that the damper needs to be set at. A return signal of 2-10V dc is provided to allow monitoring of the position.

U80.2.20 SMOKE CONTROL DAMPERS

- A Specification as per combined smoke fire dampers above, but without the fusible thermal link. Dampers to have drive open / drive close facility and no spring closure. Denoted SCD on the drawings.
- B Smoke control dampers to be classified to BS EN 13501-4.
- C Provide an addressable control system.

U80.2.21 AIRTIGHT DAMPERS

- A Where dampers are required for automatic control, or a tight shut off is necessary, then a fixed compressible neoprene or rubber gasket to be provided along the entire length of the tips of the blades to ensure an airtight seal between blades and the frame. In all cases, airtight dampers to be provided on all fresh air inlet and exhaust dampers in addition to any other locations specified.

U80.2.22 DUCT-MOUNTED ACCESS DOORS

- A Duct-mounted access doors: Fabricate access panels according to BESA specification DW/144.
- B Access doors and other openings in ductwork to be provided for the following purposes:
 - 1 For personnel for maintenance and replacement of plant items
 - 2 For routine maintenance, lubrication and adjustment of items not requiring full access
 - 3 For cleaning normal purpose ducts, a minimum of one at each change of direction, at intervals not exceeding 12 metres in straight ducts and at all points where cleaning would be obstructed by plant or equipment. Comply with TR19 as a minimum.
 - 4 For inspection and installation of equipment concealed in ducting, e.g. hand and motorised dampers; control sensors and smoke detectors
 - 5 For adequate access to fire dampers to replace fusible links
 - 6 Hand holes required to permit jointing of ductwork sections in critical locations
 - 7 Wiring and lubrication of roof extract units, axial flow fans and motors, etc.
 - 8 Either side of all duct mounted coils to allow cleaning and inspection.
- C Subject to restrictions imposed by duct dimensions access openings not to be smaller than 375mm x 300mm or larger than 450mm x 450mm.
- D Access doors in uninsulated ductwork to comprise a seamless one-piece 0.8mm galvanised mild steel frame, galvanised mild steel door complete of single wall construction with metal thickness applicable for duct pressure class.

- B Access doors in insulated ductwork to comprise of a seamless one-piece 0.8mm galvanised mild steel frame, galvanised mild steel door complete with 0.8mm outer panel, 0.55mm inner panel and minimum 25mm thermal insulation.
- C The air front seal to be provided by a one-piece moulded PVC gasket. The doors to be locked in place via quarter turn camlocks or via hard screwed wing nuts or hand wheels.
- D Small size access doors on ductwork under 300mm × 300mm must not project into the airstream.
- E Circular ducting access door to comprise of an inner and outer skin clamping ductwork between with airtight seal formed by PVC gasket or proprietary one-piece seal.
- F Insulated circular ductwork to be provided with insulated access doors with the duct insulation tapered into the frame of the access door to provide a continuous insulation surface.
- G Doors are to conform to the following minimum dimensions:

Duct size – rectangular (mm)	Door size (mm)
250 to 350	116 × 206
350 to 500	198 × 332
Above 500	325 × 463

Duct size – circular (mm)	Door size (mm)
Up to 100	80 × 180
150 to 450	150 × 250
450 to 1250	300 × 400
1250 to 400	450 × 600

U80.2.23 IDENTIFICATION MARKERS

- A Comply with BESA Specifications DW/144 for identification of ductwork.
- B Provide direction of flow markers on all ductwork to identify the service and direction of flow.
- C Markers to be of triangular shape of 150mm length of side and point in the direction of flow. Markers to be of rigid plastic laminate permanently secured to the duct or insulation, colour coded as table 18 of appendix B with white or black stencilled or printed identification symbols as BESA Specifications DW/144 Appendix B Table 19. The complete schedule of colour and identification codes to be submitted for comment prior to manufacture.
- D Direction of flow markers to be provided in all plantrooms in easily visible locations at approximately 3.5m intervals and also elsewhere at 20 metre intervals where visible plus additional markers at all access point locations and at branch connections and junctions.

U80.2.24 DUCT ACCESSORY HARDWARE

- A Instrument test holes: Cast iron or cast aluminium to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

U80.3 PART 3 EXECUTION

U80.3.1 PROTECTION (DELIVERY, STORAGE AND INSTALLATION) REQUIREMENTS

- A Ensure that ductwork is manufactured, delivered, stored and installed to minimise the unnecessary contamination of the duct systems and so minimise amount of cleaning required. Comply with the following recommendations of BS EN 15780 Table F2 appendix A and BESA DW/144.

PDI Level	Factory Seal	Protection During Transit	Protection During Site Storage	Site Clean	Cap off on site	Post Installation Clean
Basic PDI	No	No	No	No	Risers Only	No (1)
Intermediate PDI	No	No	Yes	Yes	Yes	Not unless shown to be necessary (1)
Advanced PDI	Yes ⁽²⁾	Yes ⁽²⁾	Yes ⁽²⁾	Yes ⁽²⁾	Yes ⁽²⁾	Yes

- 1 PDI level required for project is indicated in section B and/or section U10 of this specification
- 2 If inspection and testing indicate that the cleanliness is not considered acceptable due to a failure to meet acceptable dust accumulation levels for the relevant cleanliness quality class, then despite the general guidance in the table above, cleaning will be required.

- 1 Since the ductwork will be cleaned post-installation many costly and onerous procedures such as capping during transport can be dispensed with for most installations.

- B Ductwork leaving the factory may have the following conditions for the basic level of delivery:

- 1 Internal/external self-adhesive labels or marking for identification
- 2 Some exposed mastic sealant
- 3 Only a light zinc oxide coating
- 4 Only a light coating of oil
- 5 Minor protrusions of rivets into the airway
- 6 Screws, bolts, or other jointing devices
- 7 Discoloration marks from plasma cutting process

- C For definition of PDI levels refer to BESA TR/19. For the avoidance of doubt the additional protection measures in the table above have the following meanings

- 1 Factory Seal: To ensure that the ductwork leaves the factory:
 - a With any self-adhesive labels only applied to external surfaces
 - b With open ends fitted with blanking plates or capped
- 2 Protection during transit: All ductwork to be sealed and include:
 - a Blanking or capping open ends
 - c Bagging small fittings
 - d Surface wrapping or shrink-wrapping sections of ductwork
- 3 Protection during site storage:
 - a The storage area should be clean and dry and protected from site dust and this may require a boarded floor and water-resistant covering
 - e Any damaged seals to be resealed

- 4 Site Clean:
 - a The working area should be clean and dry and be protected from the elements.
 - f Internal surfaces wiped to remove excess dust immediately prior to installation
- 5 Cap off on site:
 - a Open ends of ducts sealed when complete or when left overnight during installation
- 6 Post installation Clean: This means cleaning the ductwork using the method indicated in U10.

U80.3.2 DUCT INSTALLATION

- A Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. The Indicated duct routes, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Installation Drawings and Coordination Drawings.
- B Install ducts according with the following:
- 1 BESA DW/144 standards.
 - 1 Use only contractors who are members of the BES Association.
 - 2 Install round and flat-oval ducts in maximum practical length
 - 3 Install ducts with fewest possible joints.
 - 4 Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
 - 5 Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
 - 6 Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
 - 7 Install ducts with a clearance of 25 mm, plus allowance for insulation thickness (typically 75mm overall).
 - 8 Route ducts to avoid passing through electrical equipment rooms and enclosures.
 - 9 Do not use ductwork with aspect ratios greater than 1:4 unless indicated otherwise.
- C Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 38 mm.
- D Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers or use fire rated ductwork. Refer to standard details.
- E Protect duct interiors from moisture, construction debris and dust, and other foreign materials.
- F Ensure that all ducting systems are rigid and free from any sway or movement and are true-to size, accurately lined up and free from leaks.
- G Ensure that water is prevented from penetrating all ducts emerging from the building. Arrange ductwork to drain any moisture collected inside the ductwork.
- H No pipe or conduits are permitted to pass through any duct.
- I To ensure water drains from external rectangular ductwork slope the top with sufficient fall both ways from the centre line, or one way if more appropriate. This may be achieved by either forming the top sheet of the duct or an additional continuous piece of sheet metal pop riveted to the top of the duct.
- J In addition, arrange ductwork to drain any entrained moisture and ensure the lapping of joints minimises moisture leakage.
- K All test holes drilled for the purpose of commissioning the work to be sealed with rubber grommets. Instruments and controls should be installed to manufacturers or specialist supplier's requirements. The installation must be checked by the manufacturer or specialist supplier and rectified as necessary.

U80.3.3 GENERAL WORKMANSHIP

- A During erection all open ends of ducting are to be covered to prevent entry of dust and dirt etc. using polyethylene sheeting and tape as the work progresses.
- B Ensure that ductwork bonding is electrically continuous. Provide electrical bonding terminals where necessary suitable for the connection of 6mm² conductor. Metallic ductwork systems to be bonded in accordance with the BS 7671+A1 (IEE Wiring Regulations for Electrical Installations) as part of the electrical work. The ductwork installation to undergo full electrical bonding and continuity testing.
- C Identification for ductwork to be as described in BESA Specification DW/144 Appendix B.
- D Adequately support the ductwork to avoid distortion and sagging and to permit adjustment of height to accommodate the building tolerances.
- E Angle stiffening and flanged joints must not be used for supporting the ductwork and support brackets are to be located adjacent to the ductwork joints. Ceilings, lighting fittings, pipes etc. near or under ductwork to be independently supported and must not be attached to the ductwork or ductwork support.
- F On vertical or sloping ductwork the supports and brackets are to be bolted or riveted to the ductwork to ensure rigidity and to retain the ductwork in its correct position.
- G Ductwork accessories such as dampers, attenuators, heating coils, cooling coils, air diffusers and the like to be independently supported and not supported directly from the ductwork.
- H Ductwork at low level to be supported from the floor on a channel or angle iron pedestal frame under the duct rigidly fixed to the ductwork, and a floor plate bolted directly to the floor.
- I On rigidly fixed brackets a rubber or neoprene pad / strip 5mm thick to be provided between the insulation bracket insert and the ductwork to prevent transfer of vibration. Thermal insulation and vapour barriers to be continuous over the bracket and support.
- J Ductwork to be true in section, independently supported and free from all contact with the building structure. On connections to entrained louvres and ductwork used for kitchen exhaust and moisture laid on air ductwork to be graded to drain to a trapped low point.
- K Raw edges of ductwork, formed seams, welds and rivets to be painted two coats of zinc rich paint at works and again after erection.
- L Internal jointing of ducting to be avoided wherever possible, but if unavoidable, joints to be constructed so as to minimise air turbulence at these sections and give a smooth internal surface with no reduction in cross sectional area of duct. Longitudinal standing internally formed joints or stiffening may be allowed however on large section ducts. Approval is required before internal jointing of ducting is utilised.
- M Any required angle stiffening to be external and access covers to be provided at each internal joint.
- N Mild steel angle ductwork stiffeners and steel flanges to be painted with two coats of zinc rich paint prior to fixing to duct.
- O Where other forms of construction or jointing are dictated by restrictions on space or access, seek approval from CA.
- P Ductwork is not permitted to rest directly on portions of the building except in concrete slabs or substantial walls and with the approval of the CA.
- Q Where vapour barriers are specified for thermal insulation the supports are to allow for the fitting of rigid closed cell insulation between the duct and the bracket so that the vapour seal is continuous and not penetrated in any way.
- R Should it be found that the ductwork flexes unduly additional stiffeners to be fitted at no additional cost to the employer.

U80.3.4 INSTALLATION OF EXPOSED DUCTWORK

- A Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E Repair or replace damaged sections and finished work that does not comply with these requirements.

U80.3.5 INSERTS FOR INSULATED DUCTWORK BRACKETS

- A Provide brackets on insulated ductwork with proprietary made heavy density phenolic foam (with zero ODP) circular rings or flat sections, of equal thickness to the insulation, inserted between the bracket and duct. The inserts are to incorporate a factory applied metal spreader plate and a Class O vapour barrier. The length of the insert is to extend outside the bracket by at least 15mm each side.
- B On ductwork systems operating at elevated temperatures the inserts are to be suitable for the operating conditions.
- C Vapour barriers to be continuous over the inserts and in the case of roller chairs, under the outer galvanised sheet casing.
- D Ductwork insert density is to be as follows:

Ductwork size (mm)	Density (kg/m ³)
Up to 1000	80
Over 1000	120

U80.3.6 DUCTWORK SLEEVES

- A Where ducts pass through walls, ceilings or floors which are not fire barriers, provide a 0.8mm thick galvanised sheet metal sleeve with angle iron flanges on both faces.
- B On insulated ducts, sleeves to be oversized to allow the insulation to pass between the duct and the sleeve through the wall or floor. Angle iron flanges to protrude 2mm beyond the finished surface of the wall or ceiling. Where insulated ducts pass through floors in exposed positions a protective galvanised sheet metal upstand, 300mm high with strengthening flange to be provided at the floor level.

U80.3.7 DUCTWORK SLEEVES THROUGH ACOUSTIC BARRIERS, ENCLOSURES AND PLANTROOMS

- A Sleeves on pipes and ducts which are contained in walls, ceilings or floors which are acoustic barriers, or through acoustic enclosures, or plantroom walls, floors or ceilings, to be packed with a 12mm thick resilient neoprene inner sleeve around the pipe or duct and filled with a non-setting mastic compound. The outer edges of the sleeve to be made airtight by sealing with a dense non-setting mastic compound. Where such barriers are also fire barriers the material to comply with local fire and building regulations.

U80.3.8 DUCTWORK PENETRATIONS THROUGH THE BUILDING ENVELOPE

- A Where ducts penetrate external walls roofs and floors a galvanised steel sleeve and an angle iron flange or plate to be provided, sealed to the duct and structure, suitable for flashing.

- B Penetrations through flat roofs to be completely watertight and allow water to drain freely onto the roof. A suitable sheet metal cravat to be provided with the skirt extended beyond the flashing. The flange and cravat to be weather resistant.
- C Where penetrations are made through pitched roofs a purpose made metal roof sheet is to be provided complete with a flashing plate and cravat.

U80.3.9 PROTECTIVE FINISHES

- A Mild steel sections to be galvanised after manufacture to BS EN ISO 1461.
- B External ductwork to be pre-coated PVC (plastisol) galvanised sheet metal, cold galvanised at cut edges whether it is to be insulated or not.
- C Raw edges of ductwork to be painted with one coat of aluminium or zinc rich paint before dispatch from the works and one further coat on site.
- D Ductwork for a distance of 1200mm after cooling coils, sprays and humidifiers, to be stainless steel with slip joints in the direction of condense flow.

U80.3.10 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A On kitchen exhaust ductwork and steam / moisture producing apparatus, the first 10 metres of ductwork from the apparatus or canopy to be constructed in stainless steel sheet to the same specification and installation details as galvanised sheet metal ductwork.
- B Install kitchen hood exhaust ducts without dips and traps that may hold grease and sloped a minimum of 2 percent to drain grease back to the hood and suitable drain point.
- C Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 3 m in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 38 mm from bottom of duct.
- D Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

U80.3.11 DUCT SEALING

- A Seal ducts for duct static-pressure and leakage classes specified in BESA DW/144 specification.

U80.3.12 HANGER AND SUPPORT INSTALLATION

- A Comply with DW/144 and the standard drawing details.
- B Building upper attachments must be approved by the structural engineer and CA:
 - 1 Do not use concrete inserts cast insitu to support ductwork unless to an agreed pattern (i.e. at nodes of waffle slab)
 - 2 Use concrete fasteners to support ductwork installed after placement of the concrete and removal of the concrete forms
 - 3 Do not use shot fired type bolts (i.e. powder activated fasteners). Drill holes for expansion anchors by using a carbide bit or by using teeth in the fastener itself. The expansion shield to be 'set' by driving it into the hole and expanding it with either a threaded rod hanger or bolt
 - 4 The expansion nail anchor is a light duty fastener and is to be used to support flexible ducting only
 - 5 With all types of fasteners where there are possibilities of interference with steel reinforcement in the concrete the installer must consult the structural engineer before drilling.
- C Structural steel fasteners:

- 1 Do not use shot fired (powder activated) studs and bolts on steel. Do not use spring clips, but spring hooks as indicated by the standard details may be used. Welded studs may be installed using special welding equipment. Under no circumstances should structural steel work be drilled without the prior approval of the structural engineer.
- D Hanger spacing: Refer to part 2 of this section. Wherever possible ducts should be supported as close as possible to joints. Spacing must not in any circumstances exceed 3000mm. For very wide ducts, closer hanger spacing may be required in order to limit the individual hanger loads to safe values.
- E Hangers exposed to view: Threaded rod and angle or channel supports.
- F Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at maximum intervals of 4 m.
- G Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials.
- H Hangers to be electro-galvanised threaded rod or hot-dipped galvanised rods with threads painted after installation. All hangers to be provided with screwed lengths and turn-buckles for adjustment of ducting to the required levels. All nuts to be provided with washers and locknuts and the projecting ends of bolts cut off.
- I The choice of the lower duct support will depend upon the actual duct cross section.

U80.3.13 CONNECTIONS

- A Make connections to equipment with flexible connectors as described in this specification section.
- B Comply with BESA DW/144 for branch, outlet and inlet, and terminal unit connections.

U80.3.14 PAINTING

- A Paint interior of metal ducts that are visible through registers and grilles. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

U80.3.15 DUCTWORK ACCESSORIES INSTALLATION GENERAL

- A Install duct accessories according to applicable details in BESA DW/144.
- B Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminium accessories in aluminium ducts.
- C Install back draft or control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D Install test holes at fan inlets and outlets and elsewhere as indicated.
- E Connect ducts to duct silencers rigidly.
- F Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1 On both sides of duct coils
 - 2 Upstream from duct filters
 - 3 At outdoor-air intakes and mixed-air plenums
 - 4 At drain pans and seals
 - 5 Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment
 - 6 Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links to be pressure relief access doors and to be

outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers

- 7 At each change in direction and at maximum 50-foot (15-m) spacing
 - 8 Upstream from turning vanes
 - 9 Upstream or downstream from duct silencers
 - 10 Control devices requiring inspection
 - 11 Elsewhere as indicated.
- G Install access doors with swing against duct static pressure.
- H Label access doors according to Y32 to indicate the purpose of access door.
- I Install flexible connectors to connect ducts to equipment.
- J For fans developing static pressures of 1250 Pa and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- K Connect terminal units to supply ducts as indicated on the drawings. Do not use flexible ducts to change directions.
- L Connect diffusers or light troffer boots to ducts with maximum 1200-mm lengths of flexible duct clamped or strapped in place.
- M Install duct test holes where required for testing and balancing purposes. Provide sealing grommets.

U80.3.16 PROVISIONS FOR CONTROLS

- A Make additional provisions where control sensors, thermostats, pressure switches, instruments and the like are installed in sheet metal ductwork.
- B Provisions to take the form of mounting flanges or plates and additional stiffening and bracketing is to be provided to ensure that no vibration or strain is applied to the ductwork or the control instrument etc. and the fixing is a rigid mounting.
- C On insulated ductwork, extend the hole such that it finishes flush with the insulation.

U80.3.17 CONNECTIONS TO BUILDERSWORK HOLES

- A Where ductwork, fan inlets or outlets connect directly into a builderswork duct / hole or wall, the hole to have a hardwood timber frame or angle / channel iron mating frame built in onto which the sheet metal connection to be made utilising an angle iron flange and gasket.

U80.3.18 DAMPER INSTALLATION

- A Provide sufficient dampers to accurately regulate and balance the system. Dampers on grilles or diffusers only be used for fine or secondary control. All dampers to be sufficiently rigid to prevent fluttering.
- B Dampers to be generally of the multi-leaf opposed blade type on rectangular, flat oval ductwork and on plant connections.
- C Use iris type dampers on circular ductwork less than 800Ømm.
- D Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel:
- 1 Install steel volume dampers in steel ducts
 - 2 Install aluminium volume dampers in aluminium ducts.
- E Set dampers to fully open position before testing, adjusting, and balancing.

- F Unless otherwise indicated the air leakage past dampers in the fully closed position is not to exceed 5% of the maximum design airflow in the duct. All duct dampers except fire and smoke dampers and self-closing dampers to be fitted with locking devices and position indicators.
- G The number and location of dampers to be in accordance with the CIBSE Commissioning Code Series A Air Distribution to facilitate balancing and regulation of the complete and/or part of the system. On ductwork air distribution system and extract / exhaust systems control / balancing type dampers to be installed at the following positions to regulate air flow and where shown elsewhere:
 - 1 At terminal grilles, diffusers, outlets, etc, unless a terminal balancing damper is specified with the terminal unit grille, diffuser, etc
 - 2 Within sub-branch ducts which serve 3 or more terminal units, grilles, diffusers, etc
 - 3 Within branch or zone ducts
 - 4 On fresh air inlets, exhausts and return air arrangements to regulate the volume.
- H The exact location of the dampers is to be determined by the installer to CA's approval. Take care to ensure that noise is not generated within the ductwork or breakout noise is not generated which would exceed the Specified Noise level rating of the area or area served.
- I Each primary control damper to be fitted with a non-corrodible label stating the actual air flow in m³/s and cross-sectional areas. Alternatively, these figures are to be painted in a visible position on the adjoining ductwork or insulation. The position of a damper as set after final regulation and balancing is to be indelibly marked on the damper quadrant.
- J Except as specified subsequently all isolating, balancing and control dampers to be of the single or multi-leaf type. Where minor duct dimension exceeds 100mm, multi-leaf dampers to be used. Where damper blades would be required to span in excess of 1200mm, multiple frame dampers to be used.
- K All dampers on systems where insulation and vapour sealing is specified is to be of the double skin type to allow the insulation and vapour seal to be carried over the casing.
- L On medium and high-pressure systems demountable double skin casings are to be used with only the operating spindle penetrating the outer casing to minimise leakage at bearing points.
- M All dampers to be suitable for motorised / actuator operation where applicable. Motors or thrusters to be rigidly mounted and carefully aligned on control dampers strictly in accordance with the manufacturer's instructions and recommendations.

U80.3.19 FIRE / SMOKE DAMPER INSTALLATION

- A Comply with DW/145 and the damper manufacturer's approved installation detail. Ensure that all fire damper casings are completely sealed into the structure in which they are installed. Sealing compounds to be of an approved fire rated material.
- B Ensure that all fire damper casings are firmly anchored to the wall, floor, ceiling or roof in which they are installed.
- C Access panels to be positioned within easy reach of the damper blades.
- D Seals to be inserted between the frame and the duct and between the door panel and frame.
- E Install fire and smoke dampers according to Building Fire Strategy. Comply with fire compartmentation requirements indicated on the architect's drawings.

U80.3.20 FIRE / SMOKE DAMPER INSPECTION

- A Pre-installation inspection:

- 1 Examine the areas and conditions under which the fire dampers are to be installed and correct any unsatisfactory conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner suitable to the CA.

B Post installation inspection:

- 1 Examine and ensure that the fire dampers have been installed in the correct manner fully in accordance with the manufacture's recommendations
- 2 Ensure that the fire dampers are approved by the relevant local authorities.

C In the event of problems arising with either the installation or approval of the fire dampers provide the services of an experienced competent and authorised representative of the manufacturer or supplier of the equipment to visit site to inspect, check, adjust if necessary and approve installation of all fire dampers to ensure they are acceptable to the CA.

U80.3.21 FIELD QUALITY CONTROL

A Tests and Inspections:

- 1 Operate dampers to verify full range of movement
- 2 Inspect locations of access doors and verify that purpose of access door can be performed
- 3 Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed
- 4 Inspect turning vanes for proper and secure installation
- 5 Operate remote damper operators to verify full range of movement of operator and damper.

U80.3.22 PROVISIONS FOR CLEANING

A Liaise with the ductwork cleaning specialist to ensure sufficient openings are provided to enable the efficient cleaning of the ductwork. Provide access for cleaning in accordance with BSE TR/19 and indicate below in addition to any other locations specifically mentioned in this specification or where necessary to adequately maintain the plant and equipment. All cleaning points to be clearly labelled and marked up on the as-built drawings. Ensure ductwork supports are adequate to permit cleaning including the additional weights imposed by the cleaning operations or operatives.

B Provide the following access door facilities as part of the normal ductwork installation. For additional measures relating to kitchen extract refer to section U12 of this specification.

In- Line Equipment	Location of Access doors
Control Dampers	Both sides
Fire dampers	Both sides
Heating/cooling coils	Both sides
Attenuators	Both sides
Filters	Both sides
Air Turning vanes	Both sides
Changes of Direction	One side
In-duct fans/devices	Both sides
Inlet/exhaust Louvres	One side
Intermediate cleaning panels	As required by TR/19 & DW/172

C Use access door openings for entry and inspection:

- 1 Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch thermal insulation and cladding as recommended by manufacturer.
- 2 Disconnect and reconnect flexible ducts as needed for cleaning and inspection
- 3 Remove and reinstall ceiling to gain access during the cleaning process.

U80.3.23 DUCTWORK LEAKAGE TESTING

- A Perform ductwork air pressure tests and inspections prior to the application of thermal insulation and ductwork cleaning.
- B Leakage tests:
- 1 Comply with BESA Specification DW/143 as follows:
 - a High pressure ducts: All tested
 - b Medium pressure ducts: All Tested
 - c Low pressure ducts: All Tested.
 - 2 Carry out ductwork strength and air leakage testing on ductwork in accordance with BS EN 1507 (sheet metal rectangular ducts) and BS EN 12237 (circular sheet metal ducts) .
 - 3 Perform air leakage tests and test to pressures indicated in BESA Specification DW/143 Table 22 to the appropriate ductwork classification
 - 4 Carry out the tests as the work proceeds and prior to the installation of thermal insulation
 - 5 Apply remedial measures to any sections of duct which fail to meet this standard and retest to the satisfaction of the CA.

U80.3.24 DUCTWORK INSPECTIONS FOR CLEANING

- A Carry out ductwork cleaning operations prior to commissioning and balancing of the ductwork systems.
- B General requirements: Follow the guidance in the following documents:
- 1 BS EN 15780: Ventilation for buildings – Ductwork – Cleanliness of ventilation systems
 - 2 BSEA TR/19: Guide to good practice – Internal Cleanliness of Ventilation Systems
 - 3 CIBSE TM26: Hygienic maintenance of office ventilation ductwork
- C Visually inspect the ductwork and determine, in agreement with the CA, if cleaning is necessary according to BS EN 15780 and the following guidance. System and components are considered to need cleaning when:
- 1 Visually they exhibit unacceptable levels of dust accumulation
 - 2 Visually they show microbial contamination
 - 3 Visually they exhibit other sources of contamination
 - 4 Measured dust accumulation level exceeds the required standard
 - 5 "Advanced level" PDI and/or High indoor air quality standard (IAQ1) is specified (see U10 and section B). This will apply to laboratories, treatment areas in hospitals, operating theatres, and high quality offices.
- D Elements to be inspected for cleanliness start from the outdoor air intake and include:
- 1 Air Handling Units (AHU's). AHU's assessment should include all their components and sections:
 - a outdoor air intake,
 - b mixing sections
 - c fan section,
 - d filters,
 - e plenums,
 - f heating coils
 - g cooling coils,
 - h condensate trays,

- i sound attenuators,
- j heat recovery sections,
- k humidifier section
- l droplet eliminators;
- m Supply air ductwork, including:
- n all types of terminal devices
- o terminal units,
- p sound attenuators,
- q duct-mounted heating and cooling coils,
- r dampers
- s Extract air ductwork, including all types of components;
- t Return and recirculation ductwork, including all types of components;
- u Fresh air intake ductwork.

- E If, in agreement with the CA cleaning is not deemed necessary, provide a written report on the system to verify that it has been inspected and found satisfactory. Report to be dated and countersigned by the CA or his authorised representative.
- F If the need for cleaning is disputed carry out an objective verifiable PVT test to measure the dust accumulation level and provide cleaning if the measured dust accumulation exceeds the standard required.
- G Carry out post installation cleaning of ductwork if indicated necessary by visual inspection, objective measurement of dust accumulation or if the standard of cleanliness to be achieved is "Advanced" level and indoor air quality is IAQ1.
- H Clean duct system(s) before testing, adjusting, and balancing. Use a specialist cleaning contractor.
- I If cleaning is necessary, provide a verification test upon completion of cleaning to demonstrate that the ductwork has been satisfactorily cleaned

U80.3.25 POST INSTALLATION CLEANING VERIFICATION

- A Where a verifiable test is required provide tests in accordance with BESA TR/19. If the 1st tests indicate satisfactory levels no further cleanliness testing is required. If the tests indicate that cleaning is required then a 2nd test (post clean level test) is necessary to validate the quality of the cleaning. Testing is to be carried out using the Preferred Vacuum Test (PVT) as defined in BS EN 15780

1 Acceptable dust accumulation test:

- a Carry out dust accumulation test if required to determine the need for cleaning
- b Test sections of standard duct system, for cleanliness according to "Preferred Vacuum Test":
- c Acceptable cleanliness level: Net weight of debris collected on the filter media less than the levels indicated in the table below.

Acceptable Dust Accumulation levels in new ductwork – g/m ²		
Cleanliness Quality Class	Supply, recirculation or secondary air ductwork	Extract Ductwork
Low (IAQ3)	<0.9	<1.8
Medium (IAQ2)	<0.6	<1.8
High (IAQ1)	<0.3	<0.9

- d If measurement indicates the need for cleaning (measured levels exceed those in the table) the following standard of cleaning is required to be achieved.

2 Acceptable post clean level after cleaning

- a After cleaning the ductwork and other relevant components, surfaces should be visibly clean and capable of meeting the required acceptable post-clean level.
 - b Acceptable post-clean level is $<0.3 \text{ g/m}^2$, using the PVT. Test representative sections of ductwork for verification. This applies to supply and extract ductwork.
- B Duct system will be considered defective if it does not pass tests and inspections. Cleaning and re-testing is required until this acceptable post clean standard is achieved.
- C Prepare test and inspection reports.
- D Refer to section U12 for kitchen extract ductwork requirements

U80.3.26 PREFERRED VACUUM TEST (PVT)

- A Testing to be carried out in accordance with BS EN 15780 preferred vacuum test method. Test equipment is to comprise:
 - 1 Air pump: A high volume air sampling pump capable of drawing 15 l/min through a cassette containing 37 mm matched weight or pre-weighed filters.
 - 2 Filter media: 37 mm mixed cellulose ester ('MCE') matched weight or pre-weighed filters (0.8 μm pore size) in three-piece cassette.
- B If pre-weighed filters are used, take care to desiccate samples at pre-weighing and post-exposure weighing to counter-act possible humidity effects. Other size sampling filters (pore size 0.8 μm) may be used, and care should be taken to ensure that smaller diameter filters ($<37 \text{ mm}$) are not over-loaded (they are recommended only for post-clean verification).
 - 1 calibration: Air volume rate calibration device that is accurate to $\pm 5\%$ at 15 l/min.
 - 2 Template: Approximately 0.4 mm thick, 0.01 m^2 sampling area, typically 10cm $\times$ 10 cm. other shapes can be used to suit different sampling locations.
- C Carry out the sampling according to BS EN 15780 and BESA TR/19 and obtain an independent laboratory test reports on the results. Express the results in g/m^2 . Submit results to the CA and if necessary, arrange for further cleaning and testing to be carried out.

U80.3.27 DUCTWORK SYSTEMS CLEANING

- A Clean the ductwork installation if the ductwork installation is to "Advanced Level " PDI standard and the rooms served are to high internal air quality (IAQ1) standard or if deemed necessary by inspection.
- B Note that the requirements for protection delivery and storage of ductwork are indicated in section U80.
- C Clean duct system(s) before testing, adjusting, and balancing. For kitchen extract systems refer to section U12.
- D Employ the services of a ductwork cleaning specialist to thoroughly clean all ductwork prior to commissioning. Upon completion of cleaning operations carry out tests and inspections and re-clean the installations if the tests fail to demonstrate adequate cleanliness.
- E Liaise with the cleaning specialist and provide sufficient openings to enable the efficient cleaning of the ductwork. Provide access for cleaning in accordance with U80. All cleaning points to be clearly labelled and marked up on the as-built drawings.
- F The cleaning methodology should be appropriate for the use of the building, the physical sizes of the ducts and the degree of contamination. Use can be made of any of the methodologies of section 6 of BESA TR/19 and the following table is reproduced here from that document is for guidance and typical applications;

Ductwork Cleaning Methods

	Generic Name	Energy Source	Method of removing Deposit	Typical Application
Mechanical	Rotary Brushing	compressed air and/or electricity	Brushing the surface of the ductwork using mechanical action	Dry deposits that in some places could require agitation to remove from the ductwork surfaces
	Air whip/nozzle	Compressed air	Directional jet nozzle on the end of a flexible hose	Dry, loose deposits. Not to be used where cross contamination could be an issue
	Air Lance	Compressed Air	Air gun with a trigger/lance that can be used to direct compressed air locally	internal coils/linear diffusers
Manual	Hand wipe	Manual	Wiping of the surface using a medium appropriate to the purpose	ultra clean environments
	Hand scrape	Manual	Removing heavy deposits by hand scraping	Strongly adhered deposits where arm or man access is possible
	Hand brushing	Manual	Sweeping the surface using an appropriate brush and collection device	Heavy, loose deposits in areas where arm or man access is possible
	Hand Vacuum	Electricity/Manual	Removal of deposits by means of vacuum	Loose deposits in areas where arm or man access is possible
Wet	Wet vacuum chemical clean	Electricity/Manual Mechanical/Manual	Removing liquid by means of wet vacuum Application of suitable chemicals to soften or dissolve deposits	AHUs/humidification chambers Gross soiling
	Hand wash/wipe	Manual	Washing of surfaces using an appropriate cleaning agent	Large AHUs, air intake plenums etc. and grease laden surfaces
	Steam/High pressure water wash	Electricity	High pressure system used to dislodge/dissolve deposits	concrete intake plenums and grease laden surfaces

C Cleaning techniques: The description of the various cleaning techniques is indicated below:

- 1 **Mechanical brushing:** Application ducts <600mm diameter or 500 x 500mm. Use mechanical agitation/rotary brushing to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories. Use with high volume extraction to remove and collect the deposits.
- 2 **Compressed Air Whip/ Skipper Ball:** Application ducts <600mm diameter or 500 x 500mm. Comprises compressed air source and air line with special nozzle to blast the ductwork surfaces to remove any deposits. Use with high volume extraction to remove and collect the deposits.
- 3 **Air Lance:** Application for difficult to access areas or delicate areas. Comprises an air line with a gun and trigger
- 4 **Hand Wipe:** Suitable where all internal surfaces can be reached at arm's length. Involves physically wiping all of the internal surfaces to remove deposits. Method involves the use of tack rags, anti-static dusters and lint free cloths. If cleaning agents are used comply with COSHH regulations and remove any residues with clean water.
- 5 **Hand Vacuum:** Most common method and uses with high efficiency filtered vacuum cleaner fitted with a suitable brush head to remove the surface deposits.

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- 6 **Hand brushing:** Involves brushing the surfaces of the larger ducts and collection and removal of the material.
 - 7 **Handscrape:** Application for particularly heavy deposits which are removed by scraping and then the remaining surfaces are treated using an appropriate cleaning agent and removed using the hand wipe technique.
 - 8 **Steam Clean:** Uses steam lance with trigger and appropriate head to lift and remove the deposits. Use in conjunction with detergent for removal of oil/grease deposits. Take care to protect all other building finishes when using this wet technique.
- G Carry out decontamination in a logical sequence in the direction of airflow. Diaphragms, air bags or stoppers may be used to control the direction of air flow induced by the negative air unit to ensure correct dirt removal without re-contaminating previously cleaned surfaces.
- H Carry out post cleaning verification tests to demonstrate that the correct level of cleaning has been applied to the ductwork systems.
- I Particulate collection and odour control:
- 1 When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles
 - 2 When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

U80.3.28 CLEANING OF VENTILATION SYSTEM EQUIPMENT COMPONENTS

- A These clauses indicate additional requirements for ventilation equipment which supply, recirculate or extract air from occupied areas.
- B Pre-delivery requirements: Manufacturer is required to:
- 1 Completely clean the equipment before delivery
 - 2 Protectively seal the equipment from contamination during transportation
 - 3 Ensure that all components are accessible and able to be cleaned and if necessary disinfected.
 - 4 Materials in contact with the air streams should not absorb moisture or support micro-organisms
- C The contractor is required to:
- 1 Store and protect the units so that contamination is prevented
 - 2 Preserve the unit protection during the installation and protect from dirt ingress.
 - 3 Inspect and clean units after installation
- D Air Handling units to be cleaned internally as follows: Ensure that all materials used in cleaning are applied in accordance with manufacturer's instructions and in compliance with COSHH regulations.
- 1 Casing:
 - a Ensure that air leakage does not exceed classification requirements (refer to U81)
 - b Remove filters
 - c Remove any internal rust and then apply an appropriate protective paint
 - d Brush and vacuum clean all internal surfaces
 - 2 Coils:
 - a Brush and vacuum clean
 - b Comb and straighten fins
 - c Detergent clean and rinse with pressurised water
 - 3 Condensate trays and drain:
 - a Detergent clean
 - b Disinfect using spray or gas.
 - 4 Filters:
 - a Remove filters when cleaning AHUs internally
 - b Check filter installation complies with BS EN 13053 and BS EN 13779

- c Replace filters immediately prior to handover/occupation

U80.3.29 START UP

- C Air balance: Comply with requirements in Y50 "Testing and Commissioning".

U82 FANS

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U82.1 PART 1 – GENERAL

U82.1.1 RELATED DOCUMENTS

- A For drawings and general provisions of the contract, including main contract preliminaries.
- B Related sections include the following:
 - 1 U10 Ventilation Systems
 - 2 U80 Ductwork and Ancillaries
 - 3 Y30 Mechanical Thermal Insulation
 - 4 Y31 Vibration Isolation Mountings
 - 5 Y32 Mechanical Plant and equipment identification
 - 6 Y41 Building Monitoring and management systems
 - 7 Y50 Testing and commissioning
 - 8 Y90 Fixing to building fabric.

U82.1.2 SUMMARY

- A Section includes the following types of fan systems:
 - 1 Type F3 – Scroll type Centrifugal Fans
 - 2 Type F4 – Plug type Centrifugal fans

U82.1.3 DEFINITIONS

- A The following definitions are used:
 - 1 SPL: Sound Pressure Level
 - 2 SWL: Sound Power Level
 - 3 SFP: Specific Fan Power
 - 4 AHU: Air Handling Unit.

U82.1.4 PERFORMANCE REQUIREMENTS

- A Select units to comply with the following:
 - 1 Maximum sound power levels: refer to equipment schedules
 - 2 Comply with specified noise levels
 - 3 Max fan specific power (per Fan): 0.5 kW/(m³/s) or W/(l/s)
- B Note that the SFP indicated above applies to a zonal extract system calculated in accordance with Annex D of EN BS 13779. Comply also with the current Building Regulations and if the SFP figures in the Building Regulations are less than the amount indicated above use the smaller figure.
- C Specific fan powers to be calculated in accordance with Annex D of BS EN 13779, and be no greater at 25% duty than that at 100%.
- D The equipment schedules indicate the external fan system pressure drop.
- E Provide variable speed drives for all fans.

U82.1.5 SUBMITTALS

- A Product data: For each type of product:
 - 1 Include rated capacities, furnished specialties, and accessories for each fan
 - 2 Certified fan performance curves with system operating conditions indicated

- 3 Certified fan sound-power ratings
- 4 Motor ratings and electrical characteristics, plus motor and electrical accessories
- 5 Material thickness and finishes, including colour charts
- 6 Dampers, including housings, linkages, and operators
- 7 Fan speed controllers.

B Shop drawings:

- 1 Include plans, elevations, sections, and attachment details
- 2 Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection
- 3 Include diagrams for power, signal, and control wiring
- 4 Design calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases
- 5 Vibration isolation base details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C Coordination drawings:

- 1 Show fan room layout and relationships between components and adjacent structural and mechanical elements
- 2 Show support locations, type of support, and weight on each support. Indicate and certify field measurements
- 3 Field quality-control reports.

D Operation and maintenance data:

- 1 For all fans to include in emergency, operation, and maintenance manuals.

U82.1.6 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 will be exposed.

B Ensure that the whole installation complies with the relevant standards, including but not restricted to, the following:

- 1 BS EN ISO 5136 Acoustics – Determination of Sound Power radiated into a duct by fans – in duct method
- 2 BS 7346-7 Components for smoke and heat control...calculation methods for covered car parks
- 3 BS 7346-4 Components for smoke and heat control...calculation methods employing steady state design fires
- 4 BS 7346-5 Components for smoke and heat control...calculation methods for covered time dependent design fires
- 5 BS 8519 Selection and installation of fire-resistant power and control cable systems for life safety and fire-fighting applications. Code of practice BS 848-3 Fans for general purpose. Performance testing in situ
- 6 BS ISO 10302-1 Acoustics. Measurement of airborne noise emitted and structure-borne vibration induced by small air-moving devices. Airborne noise measurement BS 848-5 Industrial fans. Mechanical safety of fans. Guarding
- 7 BS EN 12101-3 Smoke and heat control systems. Specification for powered smoke and heat exhaust ventilators
- 8 BS EN 1886 Ventilation for buildings - Air handling units - Mechanical performance (incorporating corrigendum January 2009)
- 9 BS EN 15423 Ventilation for buildings - fire precautions for air distribution systems in buildings
- 10 BS EN 12599 Ventilation for buildings - Test procedures and measuring methods for handing over installed ventilation and air conditioning systems (incorporating corrigendum No. 1)

- 11 BS EN 13779 Ventilation for non-residential buildings - Performance requirements for ventilation and room-conditioning systems
- 12 BS 7671 Requirements for electrical installations. IEE Wiring Regulations. Seventeenth edition
- 13 BS EN 12236 Ventilation for buildings. Ductwork hangers and supports. Requirements for strength
- 14 BS EN 12237 Ventilation for buildings. Ductwork. Strength and leakage of circular sheet metal ducts
- 15 BS EN 13180 Ventilation for buildings. Ductwork. Dimensions and mechanical requirements for flexible ducts
- 16 BS EN 13501-3+A1 Fire classification of construction products and building elements. Part 3 Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers
- 17 BS EN 1366-2 Fire resistance tests for service installations. Part 2 Fire dampers
- 18 BS EN ISO 1461 Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods.

C Ensure that the whole installation also complies with all relevant HVCA specifications and codes of practice DW 144, DW 154, DW 172, DW 191 and TR 19.

U82.1.7 CO-ORDINATION

A Co-ordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

U82.2 PART 2 – PRODUCTS

U82.2.1 MANUFACTURERS

- A Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1 Nuaire
- B Provide fans of the type indicated on the schedules of equipment Section D to meet the performance requirements indicated in drawings and schedules. The fans shall be manufactured by companies covered by BS EN ISO 9000 / BS EN 9001. Clause references in the schedules refer to U82 and identify the specific fan type, construction and description.

U82.2.2 FANS GENERAL

- A The design construction, materials and finishes of all fans shall be suitable for the location, climatic and operating conditions indicated in this specification and drawings. Units selected should be submitted to the CA for comment.
- B Ensure that units are of weatherproof construction if located externally.
- C Provide inverter drives for commissioning purposes for all supply and extract fans with motors larger than 1.1kW in compliance with Building Regulations.
- D Supply, install, clean, test and commission the fans as shown on the schedule and drawings. All fans shall meet the performance criteria as detailed in the schedules and drawings.
- E All fan impellers shall be statically and dynamically balanced to BS ISO 21940-14 BS ISO 11342, BS ISO 1940-1 (as appropriate) before despatch from the works and the test certificates issued to the CA. Fans selected must be capable of stable operation throughout the full capacity range.
- F All fans shall be performance tested in accordance with BS 848-1+A1 and BS 848-9 at works. All fans shall meet the specific fan power shown on the equipment schedules, or, if not provided, the minimum required by the building regulations and Non-Domestic Building Services Compliance Guide. Specific fan powers to be calculated in accordance with Annex D of BS EN 13779, and be no less at 25% duty than at 100%.
- G Select fan, motor, drive and speed control system not to exceed typical fan noise level spectra as given in CIBSE Guide and equipment schedules. Provide sound power data in accordance with BS EN ISO 5136, BS ISO 13347-1+A1, BS ISO 13347-2, BS ISO 13347-3+A1, BS ISO 13347-4.
- H Provide guide vanes for high pressure applications where the blade pitch angles are between 18 - 320°. The use of guide vanes is encouraged where their use is beneficial to the fan efficiency and stability of operation particularly in minimising the fan's tendency to stall.
- I Provide fire rated flexible sleeves on discharge and ducted suction connectors of all fans made with heavy quality glass-fibre reinforced canvas having a minimum length of 150mm securely fixed and sealed to minimise air leakage. For smoke extract applications the flexible duct connections shall be suitable for the temperature and nature of gases associated with the type of application whilst retaining the flexibility of the material.
- J Comply with the safety standards of BS EN 60335-2-80+A2.
- K Provide guards over the shaft, couplings and belts to BS EN ISO 12100 and the requirements of the factory inspectorate.
- L Shaft bearings shall be of the sealed for life type.

U82.3 PART 3 - EXECUTION

U82.3.1 INSTALLATION

- A Use only installers who are members of an appropriate trade association such as the HVCA BS&E.
- B Install fans in positions indicated, in accordance with manufacturer's instructions and recommendations in Fan Application Guide CIBSE TM42. Ensure fan is installed aligned to allow optimum air flow path. Mount impeller shaft horizontally unless otherwise indicated. Ensure that all fans and air systems are rigid and free from any sway or movement and free from leaks.
- C Fit trap to drain connection at lowest point of scroll on centrifugal fans where indicated.
- D Install axial fans level and plumb.
- E Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- F Lift and support units with manufacturer's designated lifting or supporting points.
- G Install units with clearances for service and maintenance.
- H Label fans according to requirements specified in Y32 "Mechanical Plant and equipment identification."

U82.3.2 INSPECTION, TESTING AND COMMISSIONING

- A Pre-installation inspection. Examine the areas and conditions under which the fans and systems are to be installed and correct any unsatisfactory conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner approved by the CA.
- B Post installation inspection:
 - 1 Ensure fan is isolated from installation during air leakage testing of ductwork. Examine installed fans and air systems and correct all manufacturing and erection faults or errors to the CA's approval.
- C Perform the following tests and inspections:
 - 1 Verify that shipping, blocking, and bracing are removed
 - 2 Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete
 - 3 Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches
 - 4 Verify that cleaning and adjusting are complete
 - 5 Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards
 - 6 Adjust belt tension
 - 7 Adjust damper linkages for proper damper operation
 - 8 Verify lubrication for bearings and other moving parts
 - 9 Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position
 - 10 Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage
 - 11 Shut unit down and reconnect automatic temperature-control operators
 - 12 Remove and replace malfunctioning units and retest as specified above
 - 13 Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections
 - 14 Prepare test and inspection reports.

- D Commission fans and air systems using the BSRIA pre-commissioning check list, BSRIA 3/89.3, CIBSE code of practice and section Y 51 of this specification.

U88 AIR TERMINAL DEVICES

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U88.1 PART 1 – GENERAL

U88.1.1 RELATED DOCUMENTS

- A For drawings and general provisions of the contract, including main contract preliminaries.
- B Related sections include the following:
 - 1 U10 Ventilation Systems
 - 2 U80 Ductwork and Ancillaries
 - 3 Y50 Testing and commissioning
 - 4 Y90 Fixing to building Fabric.

U88.1.2 SUMMARY

- A Section includes:
 - 1 Round ceiling diffusers
 - 2 Weather louvres

U88.1.3 PERFORMANCE REQUIREMENTS

- A Grilles and diffusers shall be provided in accordance with the following descriptions and the schedule and shall comply with stated air quantities and throws. Wherever indicated the room noise level rating shall not be exceeded with the system operating at its maximum duty and taking into account all accumulative effects of the diffusers, area served, and noise regenerated by regulating/balancing dampers immediately behind the diffuser or grille to provide the correct air volume flow rate.
- B Diffusers shall be draught free, shall provide rapid mixing of primary and recirculation air to ensure that the design air movement and room temperature gradient is not exceeded. In this respect the maximum velocity at 1.5m height shall not exceed 0.26m/s and the room temperature gradient shall not exceed 2°C from floor to normal office ceiling heights.
- C Air diffuser pressure drops shall be selected to ensure that the noise rating of the diffuser is not exceeded.
- D The acoustic and aerodynamic performance rating of all diffusers, grilles and other terminal devices shall have been established using the methods stated in BS EN 12238, BS EN ISO 5135 or approved equivalent international standard.
- E For underfloor plenum air tightness testing refer to Y50

U88.1.4 SUBMITTALS

- A Product data: For each type of product indicated, include the following:
 - 1 Data sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, and noise ratings
 - 2 Diffuser, register, and grille schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B Samples for initial selection: For diffusers, registers, and grilles with factory-applied colour finishes.
- C Samples for verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify colour selected.
- D Co-ordination drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and co-ordinated with each other, using input from Installers of the items involved:
 - 1 Ceiling suspension assembly members
 - 2 Method of attaching hangers to building structure

- 3 Size and location of initial access modules for acoustical tile
 - 4 Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special mouldings
 - 5 Duct access panels.
- E Source quality-control reports.

U88.1.5 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 Ensure that the whole installation complies with the relevant standards, including the following:
- 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 3987 - Specification for anodic oxidation coatings on wrought aluminium for external architectural applications.
 - 3 BS EN 12238 - Ventilation for buildings. Air terminal devices. Aerodynamic testing and rating for mixed flow application
 - 4 BS EN 13030 - Ventilation for buildings. Terminals. Performance testing of louvres subjected to simulated rain
 - 5 BS EN ISO 5135 - Acoustics. Determination of sound power levels of noise from air-terminal devices, air-terminal units, dampers and valves by measurement in a reverberation room.
 - 6 BS EN 485 parts 1-4: Aluminium and aluminium alloys. Sheet strip and plate Part 2+A1
 - 7 BS EN 515 - Aluminium and aluminium alloys. Wrought products temper designations
 - 8 BS EN 573 - Aluminium and aluminium alloys: Chemical composition
 - 9 BS EN 755 - Aluminium and aluminium alloys. Extruded rod/bar, tube and profiles
 - 10 BS EN 1991 1-4+A1: Eurocode1. Actions on structures. General actions.
 - 11 BS EN 12206-1. Paints and varnishes. Coating of aluminium and aluminium alloys for architectural purposes. Coatings prepared from coating powder

U88.2 PART 2 – PRODUCTS

U88.2.1 AIR TERMINAL DEVICES – GENERAL

- A Provide air distribution devices of extruded aluminium construction either stove enamelled or polyester powder coated to RAL colour as defined in the schedules or detailed by the architect.
- B Provide spring loaded or other approved friction devices on all adjustable dampers or vanes so that they remain permanently in their set position without vibration or noise.
- C Provide neoprene or similar gaskets to all air diffusing devices to eliminate air edge leakage. Particular attention is required to joints between plenum boxes and linear diffusers.
- D All air distribution devices shall be constructed in accordance with the best current practice and free from sharp edges.
- E Unless stated otherwise, all grilles and diffusers shall be manufactured from minimum 1.5mm extruded aluminium to BS EN 485, BS EN 515 and BS EN 573, or BS EN 755. Outer frames shall be formed from welded mitre corners and contain keyways to facilitate independent suspension of the unit to the ceiling slab, wall structure of plenum box without the use of surface screws. This shall be achieved by the use of suspension brackets or universal fixing brackets.
- F Ceiling diffusers shall be selected to match the architects ceiling plan and shall be of the surface overlapping, recessed flush or lay in "T" bar type. Liaise with the manufacturers to ensure compatibility.
- G All linear diffusers shall have positive alignment of adjacent sections by means of key stirrups and alignment slots in the frame.

U88.2.2 CEILING GRILLES

Type CG4: High pressure circular supply or evacuating controller manufactured from pressed steel and consisting of a separate mounting frame and removable core. Control of the pressure drop shall be by rotary adjustment of the central disc and provision shall be made for locking of the disc.	

U88.2.3 LOUVRES GENERAL

- A Where louvres have an architectural impact, they will be as detailed in the architectural specification and scheduled elsewhere.
- B Where louvres are to be supplied by the Building Services Contractor, provide louvres as indicated on the equipment schedules and/or drawings.
- C Performance: Provide louvres with the weather performance classification indicated in the schedules when tested according to BS EN 13030. Where acoustic louvres are indicated provide louvres to meet the static acoustic Insertion loss ratings in addition to the weather performance requirements.
- D Where not indicated in the schedules provide louvres in accordance with the following applications and design performance table.
 - 1 **Rain Penetration Class A:** Use for all air intake and discharge applications for moderate to severe wind speeds or exposed locations and areas where no rain water penetration is acceptable.
 - 2 **Rain Penetration Class B:** May only be used for air intake and discharge with express approval of the CA and only in sheltered locations with low wind speeds and areas where some rain penetration is acceptable for a very short distance. May also be used for screening purposes without seeking special approval.

- 3 **Rain Penetration Class D:** Where maximum air flow is required but rain defence is not important. For general screening applications around exposed plant and equipment.
- 4 **Aerodynamic performance:** Indicated by the Classification Index at the design louvre core/face velocity based on the overall area of the louvre with louvre blades removed. The maximum aerodynamic pressure drop is also indicated. Discharge loss coefficient represents the fraction of the physical area of flow which is the effective area of flow.

Water Penetration Effectiveness Classification BS EN 13030	Air Flow Classification BS EN 13030	Max Design Core (Face) Velocity m/s	Max Design Pressure Drop Pa	BH Type	Max Test Rain Penetration l/h/m ²	Minimum Test Discharge Loss Coefficient
A	2	1.0	25	L2	0.75	0.31
B	2	1.5	25	L2	3.75	0.32
D	1	2.0	25	L1	15.00	≥0.4

- 5 **Wind Loading:** Provide and design the louvres with a supporting structure to withstand the design wind load and resistance suitable for the degree of exposure to weather as defined and calculated by the methodology of BS EN 1191-1-4.

E Louvres shall be either single or of multi-panel construction with non-visible mullions. Construction as follows:

- 1 Materials:
 - a Aluminium extrusions: BS EN 485, BS EN 515 and BS EN 573, or BS EN 755
 - b Thickness: Frame: 2 mm. Blades: 1.5mm. Mullions: 3 mm.

F Provide louvres with one of the following finishes as indicated on the schedules of equipment or drawings and colour as indicated or approved by the CA. Where no finish is indicated on the schedules provide polyester powder coated finish.:

- 1 Mill aluminium
- 2 Anodised to BS 3987, colour as scheduled (silver, black, bronze, blue-grey)
- 3 Polyester Powder Coated BS EN 12206-1
- 4 Syntha Pulvin
- 5 Zero VOC fluoro-polymer powder coated
- 6 PvF2: Polyvinylidene Fluoride

G Where louvres are to be used in combination with other louvres there should be a minimum free gap of 50mm and due allowance should be made for the increased air flow resistance.

U88.3 PART 3 - EXECUTION

U88.3.1 EXAMINATION

- A Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B Proceed with installation only after unsatisfactory conditions have been corrected.

U88.3.2 INSTALLATION

- A Install diffusers, registers, and grilles level and plumb.
- B Ceiling-mounted outlets and inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the centre of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors and fire dampers.

U88.3.3 ADJUSTING

- A After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

V11 LOW VOLTAGE CONNECTION

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V11.1 PART 1 – GENERAL

V11.1.1 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 schedules of equipment.
- C For system descriptions, operating conditions refer to section B of this specification and the Schedules of Equipment.
- D Refer also to the following sections:
 - 1 Low Voltage Distribution systems – V30
 - 2 Low Voltage Switchgear – V31
 - 3 Electrical Identification – V80
 - 4 Earthing and Bonding Systems – V81
 - 5 Electrical Inspection and Testing – Y50.
- E Where relevant this document is to be read in conjunction with the following:
 - 1 For Building Monitoring and Management – Y41
 - 2 For LV and ELV Cables – Y61
 - 3 For Cable Supports – Y63
 - 4 For fixing to Building – Y90.

V11.1.2 SUMMARY

- A This Section covers Low Voltage connections including equipment for electricity metering by the utility company and electricity metering by a private wire network operator.
- B It includes the following equipment:
 - 1 Service cable
 - 2 Cut Out
 - 3 LV Current Transformers
 - 4 CT Chambers
 - 5 Metering and Accessories.

V11.1.3 DEFINITIONS

- 1 A.C: Alternating Current
- 2 D.C: Direct Current
- 3 ACB: Air Circuit Breaker
- 4 DNO: District Network Operator
- 5 PES: Public Electricity Supply
- 6 PWN: Private Wire Network
- 7 ICP: Independent Connection Provider
- 8 PME: Protected Multiple Earth
- 9 High Voltage (HV): Voltage $\geq 35\text{kV}$ but for this document also includes MV
- 10 Medium Voltage (MV): Voltage $\geq 1.0\text{kV}$ and $\leq 35\text{kV}$ referred to as HV in this document
- 11 Low Voltage (LV): 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
- 12 Extra Low Voltage (ELV):
 - a A.C.: $<50\text{V}$
 - b D.C. $<120\text{V}$ ripple-free

- 13 KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter
- 14 CT: Current Transformer used to feed into the electricity meter a signal proportional to the current flowing through the load
- 15 VT: Voltage Transformer
- 16 PC: Personal computer
- 17 BNO: Building Network Operator
- 18 BMS: Building Management System
- 19 AMR: Automatic Meter Reading - an older technology that only collects electrical energy consumption and transfers that data from the electric meter to the utility (one-way communication)
- 20 AML: Advanced Metering Infrastructure - AML meters, also known as Smart meters are updated, digital versions of the traditional electrical meter. These new meters not only measure how much electricity is used, but also at what times during the day. Smart meters are also designed to transmit pricing and energy information from the utility company to the consumer (two-way communication).
- 21 PV: Photovoltaic
- 22 CHP: Combined Heat and Power
- 23 G59-3: DNO compliant controller to permit connection to PES
- 24 TMFC: Transformer Mounted Fuse Cabinet.

- B Authorised Person (LV): a person trained and appointed to take responsibility for the effective management of the safety guidance given in BS 7671 and holding an appropriate qualification in Electrical Engineering recognised by the DNO.
- C Competent person: A person recognised by the DNO as having sufficient technical knowledge and/or experience to enable him/her to avoid danger and safely work on electrical installations. Able to accept a safety document such as a "Permit to Work" form the Authorised person.
- D OFGEM: The office of Gas and Electricity Markets.

V11.1.4 PERFORMANCE REQUIREMENTS

- A To provide a LV connection to a public or private electricity supply. Refer to section B which indicates the provider of the incoming supply.
- B Obtain existing records of any services connecting to or crossing the site. Make any searches that are required to identify all services which may have an impact upon the site. Discuss proposals for diversions and connections with the relevant supply authority.
- C Provide the new LV electrical supply/supplies to the project as indicated on the drawings and which will be of the following type and as identified in section B of this specification:
- 1 Public: Connection to public electricity supply (PES) which will be provided and operated by the District Network Operator (DNO):
 - a Prepare an application for the supply/ies from DNO and obtain quotations for the work from Utility Company
 - b Refer to section A & B of this specification for responsibilities for making application and general co-ordination with the DNO.
- D Provide the supply authority with the details of the loads at each point of connection including following information:
- 1 Proposed location of the incoming supply/ies
 - 2 Access details
 - 3 No of connections required
 - 4 Load at each connection point (kVA)
 - 5 Nature of loads to be connected:
 - a Load: kW rating,

- b Phase: single or 3 phase
- c starting frequency
- d starting method: DOL, star delta or Soft start
- e Starting Current: A.

E For PES connection: Determine the incoming voltage in discussion with the DNO. Request details of the maximum prospective short circuit current to determine the short circuit rating requirement of electrical equipment.

F The LV Connections for this project comprise:

- 1 Two and three phase: 230V (phase-neutral) and 400 V (phase-phase)

G Where the supply is from a DNO, supply and install utility metering in accordance with Utility supply regulations. Engage the DNO to provide the service cable and Cut-out and provide backboard for mounting of Electricity supply company meters.

H The following table provides a summary of the typical LV supply arrangements.

Max Power Required (kVA)	Service Cable	Rating and Termination	Max. Fuse Rating (A)
0 - 23	35mm ² Single-phase	100A Single-phase cut-out	100
24 - 69	35mm ² Three-phase	100A Three-phase cut-out	100
70 - 138	95mm ² Three-phase	200A Three-phase cut-out	200
139 - 217	185mm ² Three-phase	400A Three-phase cut-out	315
218 - 277	300mm ² Three-phase	400A Three-phase cut-out	400
278 - 415	Cables to be specified and provided as indicated on the drawings	800A LV Way	630
316 - 555		800A LV Way	800A LV Way
556 - 1000		1600A ACB	1600A ACB
1000+ to be provided at HV see section V10			

I 100A TPN Supplies: Where indicated provide:

- 1 A 100A TPN supply via a 35mm² three-phase service cable terminated into a three-phase 100A cut-out
- 2 Comply with the DNO requirements for the setting out of the components
- 3 Use of a pup busbar allows up to a maximum of four direct services to be supplied from the three-phase 100A cut-out. Note: Check and seek approval from DNO for the use and application of this arrangement
- 4 CT metering is not available for 100A TPN supplies; these shall be whole current, full settlements metered. The ownership boundary is at the outgoing terminals on the cut-out.

J 200A - 400A TPN Supplies: Where indicated provide:

- 1 A 200A to 400A TPN supply via 95mm² – 300mm² three-phase service cables terminated into a heavy-duty cut-out connected to a CT chamber
- 2 Comply with DNO requirements for setting out of the installation components
- 3 All cut-outs to use bottom entry as standard
- 4 Service length shall be limited to ensure a maximum voltage drop of 3% at the customer cut-out
- 5 The ownership boundary can be either:
 - a For Partial settlements: at the outgoing terminals of the DNO CT cabinet
 - b For Full settlements: at the outgoing terminals of the cut-out.

K 400A - 800A TPN Supplies; Where indicated provide:

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- 1 400A to 600A TPN supply from an on-site substation via either:
 - a 800A 5-way TMFC fused at 630A, or;
 - b 800A LV board extension fused at 630A.
- 2 600A to 800A supply from an on-site substation of no less than 800kVA via either:
 - a 800A 5-way TMFC fused at 800A, (Note: The 800A way occupies 2 LV ways, leaving 3 LV ways for LV network use on a 5-way TMFC.) or;
 - b 800A LV board extension fused at 800A.
- 3 It is not possible to equip a substation of less than 800kVA with an 800A way due to network protection discrimination.
- 4 Equip both TMFC and LV board extension with integral metering CTs on the outgoing (load) side
- 5 Locate the on-site substation directly adjacent to the supply intake position and where practicable at a boundary location with access from the public highway
- 6 The ownership boundary is at the outgoing terminals of the TMFC or LV board extension.

L 800A - 1600A TPN Supplies: Where indicated provide:

- 1 800 to 1600A TPN supply via an ACB in a 5-way TMFC with a spare 630A way equipped with integral metering CTs on the outgoing (load) side
- 2 Locate the on-site substation directly adjacent to the supply intake position and where practicable at a boundary location with access from the public highway
- 3 Note: The single spare 630A LV way may be used for limited LV backfeed to the property where feasible
- 4 The ownership boundary is at the outgoing terminals of the ACB.

M Supply all LV metering as indicated on the drawings including CTs, and VTs. Include for all associated costs for the supply and installation of the metering. All metering shall be accessible to the network operator meter readers and local regulations:

- 1 For High voltage metering refer to section V10
- 2 Obtain all necessary DNO or PWN Company approvals for the metering installations prior to purchasing or installing any Utility metering
- 3 Provide pulsed meters to permit remote monitoring and remote reading of meters.

N For energy monitoring metering of end use in compliance with the building regulations refer to section V31& V21.

O Design and install all LV switchgear and distribution equipment within separate switchrooms/areas allocated for each particular project as indicated on the drawings. For switchgear specification refer to section V31.

P 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.

V11.1.5 SUBMITTALS

A Refer to Section A of this specification.

B Product Data: For each type of product indicated:

- 1 Cut-outs
- 2 Meters
- 3 LV Switchgear.

C Shop Drawings: For electricity-metering equipment:

- 1 DNO compliant drawings for incoming supply/ies with dimensioned plans and elevation layouts
- 2 Builderswork provisions for incoming services including plinths, backboards, ducts and trenches and openings in the structure

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- 3 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
 - 4 Shop drawings to include local utility requirements including meter wiring details, CT and VT arrangements.
- D Field quality-control reports. (refer to Y50 for testing and commissioning records).
- E Operation and Maintenance Data. In addition to items specified in "Operation and Maintenance Data," include the following:
- 1 Application and operating software documentation
 - 2 Software licenses
 - 3 Software service agreement
 - 4 Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

V11.1.6 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 Electrical Components, Devices, and Accessories: Listed and labelled as defined in the local wiring regulations, and marked for intended location and application.
- C Ensure that the whole installation complies with the relevant standards, including the following:
- 1 British Standards & Regulations:
 - a BS EN 60044-1 Current transformers
 - b BS EN 60044-2 Voltage transformers
 - c BS EN 60129 Specification for alternating current disconnectors and earthing switches.
 - d BS EN 62271-100/200 Specification for A.C. metal enclosed switchgear and control gear.
 - e BS EN 60529 Specification for degrees of protection provided by enclosures (IP code)
 - f BS EN 62053-11 - Electricity metering equipment (ac). Particular requirements. Electromechanical meters for active energy (classes 0, 5, 1 and 2)
 - g BS EN 62053-23 - Electricity metering equipment (ac). Particular requirements. Static meters for reactive energy (classes 2 and 3).
 - h Approved Code of Practice for Management of Health and Safety at Work Regulations 1999.
 - i BS 7671:2001. Requirements for electrical installations. IEE Wiring Regulations.
 - j Construction (Design and Management) Regulations.
 - k Electricity at Work Regulations
 - l Electricity Safety, Quality and Continuity Regulations
 - m Health and Safety (Safety Signs and Signals) Regulations.
 - n Health and Safety at Work etc Act
 - 2 The Institution of Electrical Engineers'
 - a 'Code of practice for in-service inspection and testing of electrical equipment'.
 - b 'Guidance Note 3 – Inspection and testing'.
 - 3 The Health & Safety Executive's:
 - a 'Electricity at work: safe working practices HSG85'.
 - b 'Keeping electrical switchgear safe HSG230'.
 - 4 'Memorandum of guidance on the Electricity at Work Regulations 1989 HSR25'.
 - 5 'Safety in electrical testing at work INDG354'.

V11.1.7 DELIVERY, STORAGE, AND HANDLING

- A Receive, store, and handle modular meter cabinets and LV enclosures according to manufacturer's requirements.

V11.1.8 PROJECT CONDITIONS

- A Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Employer or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
- 1 Do not proceed with interruption of electrical service without CA's written permission.

V11.1.9 COORDINATION

- A Electrical Service Connections: Coordinate with DNO operators and components they furnish as follows:
- 1 Comply with requirements of DNO providing electrical power services
 - 2 Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

V11.2 PART 2 - PRODUCTS

V11.2.1 LV CONNECTION GENERAL

- A For underground building service entry comply with specification P30 and the requirements of the DNO operator. The supply may take the form of a single DNO intake or multiple supplies from a substation of LV switchboard.
- B Single DNO intake:
- 1 Provide for the service cable and cut-out to meet the requirements of the DNO operator.
 - 2 Provide space and backboard for the installation of Electricity supplier meter/CT chamber and meter panel or private meter
 - 3 Electricity supplier to supply and install the main fuse and meter. Provide meter tails for connection by the Electricity supplier
 - 4 Ensure that the ownership boundary is indicated by use of an approved boundary label.
- C Substation or LV switchboard: Where appropriate metering for separate consumer supplies may be contained within an LV distribution board if there are a number of metered supplies. In this case metering will be by the BNO rather than the electricity company.

V11.2.2 CUT OUTS

- A For PES installation the DNO or their accredited contractors will bring the service cable to the connection point (cut-out).
- B Cut out supplied by DNO to be suitable for the incoming cable rating and load to be applied.
- C For consumer unit (distribution board) details refer to V30

V11.2.3 LV CURRENT TRANSFORMERS AND METERING:

- A Application: For loads in excess of 100A provide current transformers.
- B For PES network connections ensure meters and current transformers comply with the Electricity supplier requirements.
- C Provide measuring current and voltage transformers of suitable class and accuracy to meet the specified/intended duty:
- 1 Ensure the rated VA output is suitable for the type and magnitude of the connected load
 - 2 Ensure current transformers for metering and control purposes are of minimum accuracy Class 0.5.(BS EN 60044-4)
 - 3 Ensure the accuracy limit factor for 5P and 10P CT's is appropriate for the protection scheme and greater than the highest available setting of any instantaneous element. Ensure the 'knee' point voltage of Class X CT's is sufficient for correct operation of the protection scheme and can maintain stability for 'through fault' conditions
 - 4 Knee point calculations to be provided
 - 5 Do not insert isolating contacts in circuits between CTs and protective devices
 - 6 Ensure the removal of protection relay from its case will 'short circuit' the connected CTs
 - 7 Ensure all CT ratings, ratios, types and classes etc. are identified internal and external to the CT chamber on all equipment.
- D There are four main types of instrument current transformers:
- 1 Ring type: can be circular or rectangular. The conductor has to be dismantled at one end to fit the CT

- 2 Split-core: the CT splits into two pieces so that it can be fitted around the conductor. (only used for existing installations in which it is not possible to disconnect one end of the cable or bus bar.)
 - 3 Summation: can be in a rectangular box or in a ring. Used to add together the outputs from several CTs forming a number of supplies
 - 4 Wound-primary: the conductor is wired into the CT rather than passing through it. (used for low turn down ratios 20/5A).
- E Construction: Compact moulded case current transformers suitable for primary currents from 25A to 500A. Indoor use only:
- 1 Standards: IEC 185, BS 7626, BS EN 60044-1 and IEC 60044-1
 - 2 Class: 0.5
 - 3 Rating: 7.5VA
 - 4 Short time Withstand: 46KA for 0.5 s
 - 5 Frequency: 50Hz
 - 6 Transformer type: DIN Rail Mounted
 - 7 Temperature: -30°C to +85°C.

V11.2.4 CT CHAMBERS & METER PANEL

- A Standard CT Chambers are designed to house Current Transformers used to meter LV electrical supplies rated from 200A to 1600A. Versions are available that are combined with a 4P MCCB, which also provide a main point of isolation for an installation.
- B Before ordering a CT chamber, please confirm who has responsibility for supplying the CT chamber with your electricity supplier. Normally they are supplied by the DNO/PWN operator.
- C CT chamber to be of one of the following types to the requirements of the DNO/PWN operator:
- 1 Stand alone
 - 2 CT/MCCB.

V11.2.5 METERING GENERAL

- A Ensure all indicating instruments are of an approved manufacture and size to conform with the relevant Standard.
- B Ensure the markings on the dials include the scale markings the instrument transformer ratio and British Standard grading.
- C Ensure all instruments are:
- 1 Flush mounted
 - 2 Back connected c/w terminal shrouds or covers.
 - 3 Provided with means for zero adjustment
 - 4 Metric fixings
 - 5 Minimal terminal size of M4.
- D Use ammeters complying, where appropriate, with the relevant Standards, Class Index as detailed above, of moving iron type with external zero adjustment, flush mounting housed in pressed steel or plastic case with escutcheon plate, finished matt black.
- E Use instruments of compatible appearance, size and finish, mounted as near as possible to associated equipment. Shroud all instrument terminals. Use dials of sizes as noted above.
- F Allow for ranges covering zero to 125% of circuit switch rating but verify ranges prior to ordering switchpanel.
- G Connect ammeters, in the black or yellow phase unless a selector switch is specified. Ensure that selector switches for ammeters are of the 5-position type including OFF position to give the values in each phase

and in the neutral conductor. Scale voltmeters so that the normal reading, which is marked with a red line, appears on 2/3 full scale deflection. Provide selector switch if required.

- H Ensure all voltage connections to meters are individually fused and CT connections are made through shorting link terminals, such that meters can be replaced without disruption to supply.
- I House instruments associated with switchgear in separate compartments.

V11.2.6 TARIFF METERING

- A In general, each main LV incoming switchboard/MCC serving a building or area is to be provided with Polyphase multi-parameter electricity meter complying with Ofgem requirements for the incoming supply, with digital output pulse for connection to telemetry system and direct LED readout. The unit is to be housed in a separate compartment, containing voltage fuses, CT isolating terminals/links, and any associated equipment.
- B Ensure protection and metering to low voltage equipment is in accordance with the particular project requirements as indicated on the drawings and this specification.

V11.2.7 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

- A Where indicated on the drawings and specification the meters will be furnished by the DNO utility company.
- B Supply and install utility metering in accordance with Utility supply regulations. Supply all metering as indicated on the drawings including CTs, and VTs. for Low Voltage metering.
- C Include for all associated costs for the supply and installation of the utility metering throughout the building. All metering shall be accessible to local Utility Company meter readers as required by the local regulations. Allow for pulsed metering to allow remote monitoring and remote reading of Utility meters.
- D LV Switchboards; Meter compartment:
 - 1 Comply with requirements of DNO/electrical-power utility company
 - 2 Comply with section V31.

V11.2.8 METER CABINET BOX

- A Where indicated provide a flush mounted or surface mounted meter cabinet. Provide incoming 38mm duct with approved "Hockey stick" arrangement to permit future installation of the service cable by the DNO.
- B Recessed Type: Construction: Weather resistant non-corrodible. Provide fire retardant version if adjacent to escape routes or where required by Building Control. Typical construction:
 - 1 Material: GRP
 - 2 Standard: BS 8567
 - 3 Dimensions: 409mm W x 595mm H x 210mm Deep
 - 4 Complete with
 - a Fitted base board
 - b meter box key
 - c Pre-drilled cable entry positions
 - 5 Colour: white or brown

V11.3 PART 3 - EXECUTION

V11.3.1 LOW VOLTAGE SAFETY REGULATIONS

- A Ensure all persons operating or working on an LV System comply with instructions from Authorised Person (LV).
- B Ensure Electrical Installer (or Specialist - if used) appoints fully trained 'Competent Persons' to supervise specified LV works and to receive 'permits to work' from an Authorised Person.
- C Ensure no work on LV systems is undertaken without first obtaining Permit to Work from Authorised Person.
- D Ensure no person enters a sub-station or high voltage enclosure unless accompanied by an Authorised Person (HV) or covered by a Permit-to-work issued by the Authorised Person.
- E Provide 150 -300mm incoming duct to accommodate incoming power cables. Comply with the requirements of P30 and install draw wires so that future cable installation can be accommodated.

V11.3.2 INSTALLATION GENERAL

- A Comply with equipment installation requirements in BS EN 61439-1.
- B Ensure the following is provided prior to the installation of the DNO equipment:
 - 1 Fit main switch, appropriate to the kVA requested
 - 2 Fit the correct size trunking from the main switch to proposed site for the DNO's CT chamber. Trunking should have a slot cut into it to allow the tails to pass into the DNO's CT chamber. A grommet should be fitted to this slot to prevent any mechanical damage to the tails
 - 3 All earth conductors need to be in place and connected, including bonding to all other services
 - 4 The correct size tails, appropriate to the kVA requested, should be terminated on secondary side and made available for connection by DNO to their network
 - 5 Fit correct size of trunking from main switch.
- C For PES installation: Install meters furnished by Electricity supplier. Install trunking and equipment according to utility company's written requirements.
- D Install TMFC according to BS EN 61439-2 switchboard installation requirements.
- E Before connecting to any network provide a completion certificate as identified in BS 7671 and allow supply authority to conduct a range of tests to be satisfied that the installation is safe for energising and that any fault currents which may arise are cleared before injecting into the DNO or PWN networks.

V11.3.3 100A TPN CABLE INSTALLATION

- A Provide and maintain the LV tails from either the metering points of isolation or a single point of isolation from the outgoing terminals of the cut-out.
- B The point of isolation may be an isolating switch, a fuse or link in a cut-out, either integral to the intake position, distribution equipment or a standalone device.
- C Armoured cables shall not be terminated into a 100A TPN cut-out.
- D Provide suitable trunking to contain the LV tails between the metering cabinet(s) and the customer's point of isolation and installed and maintained in accordance with BS 7671.

V11.3.4 200A TO 400A TPN CABLE INSTALLATION

- A Provide and maintain LV tails from the point of isolation to the outgoing terminals of the CT chamber.

- B The point of isolation may be an isolating switch, a fuse or link in a cut-out, either integral to the intake position, distribution equipment or a standalone device.
- C Armoured cables shall not be terminated into a 200A to 400A TPN cut-out.
- D Provide suitable trunking to contain the LV tails between the metering cabinet(s) and the customer's point of isolation and installed and maintained in accordance with BS 7671.

V11.3.5 400A -800ATPN CABLE INSTALLATION

- A Provide, install, and maintain the cable from the TMFC or LV Board.
- B Provide cables of a type suitable for termination in the TMFC or LV board. Cables to be selected and installed in accordance with BS 7671.
- C Armoured cables are acceptable for TMFC or LV board terminations. The armour shall be terminated at the customer end only and secured in a plastic gland within the substation.
- D The minimum cross-sectional size of the neutral conductor shall be the same size as phase conductors. Alternatively, the cross-sectional size can be determined in accordance with BS 7671:2011 Regulation 524.2.
- E The minimum cross-sectional size of a copper earth conductor shall be half the size of the phase conductors in accordance with BS 7671:2011 Regulation 543.1.4. Alternatively, the cross sectional size can be calculated in accordance with BS 7671:2011 Regulation 543.1.3.
- F Advise DNO of the number and size of LV tails to be installed so that the civil works can be designed accordingly. Fit suitable termination lugs provided by DNO onto their cables. Provide appropriate physical protection for the cables between the ownership boundary and the customer's point of isolation in accordance with BS7671.
- G Cables to be terminated in the LV equipment within the substation by DNO staff.
- H The point of isolation may be an isolating switch, a fuse or link in a cut-out, either integral to the intake position, distribution equipment or a standalone device.

V11.3.6 800A-1600A TPN CABLE INSTALLATION

- A The customer shall provide, install, own and maintain the cable from the ACB.
- B The cables shall be of a type suitable for termination in the ACB. Cables to be selected and installed in accordance with BS 7671.
- C Armoured cables are acceptable for the ACB terminations. The armour shall be terminated at the customer end only and shall be secured in a plastic gland within the substation.
- D The minimum cross-sectional size of the neutral conductor shall be the same size as phase conductors. Alternatively, the cross-sectional size can be determined in accordance with BS 7671:2011 Regulation 524.2.
- E The minimum cross-sectional size of a copper earth conductor shall be half the size of the phase conductors in accordance with BS 7671:2011 Regulation 543.1.4. Alternatively, the cross sectional size can be calculated in accordance with BS 7671:2011 Regulation 543.1.3.
- F The maximum length of the cables will be determined by the need to ensure that the ACB provides the required protection for the cables in the event of an earth fault.
- G Advise DNO/PWN of the number and size of LV tails to be installed so that the civil works can be designed accordingly. Fit suitable termination lugs onto their cables provided by DNO. Provide an appropriately sized earthing conductor from the main earth bar of the customer LV installation to DNO LV earth terminal. Provide appropriate physical protection for the cables between the ownership boundary and the s point of isolation in accordance with BS7671.
- H Cables to be terminated in the LV equipment within the substation by DNO staff.

- I The point of isolation may be an isolating switch, a fuse or link in a cut-out, either integral to the intake position, distribution equipment, circuit breaker or a standalone device.
- J Ensure that:
 - 1 the characteristics of the ACB provide effective short circuit protection for the size of LV tails selected
 - 2 an LV fault at any point up to the customer's first circuit breaker or fuse will trip the ACB within five seconds
 - 3 protection settings for the ACB provide the maximum grading margins for protection, while also ensuring discrimination with the HV protection.
- K Obtain from DNO a copy of the applicable ACB protection settings and the maximum earth loop impedance value at the ACB terminals.
- L ACB emergency trip facilities may be provided in accordance with DNO requirements.

V11.3.7 CUT OUT INSTALLATION

- A Comply with the following or specific DNO operator requirements:
 - 1 For 100A TP & N entry
 - a Height from finished floor to Top of cut out: 500mm min, 1200mm maximum
 - b Maximum cut-out dimensions: 270mm high, 185mm wide, 250mm deep
 - c Working space in front of cut out: 1000mm minimum
 - d Area for metering: 500W x 468mm high with 150mm clear separation between cut out.
 - 2 For 400A (heavy duty) entry comply with the following:
 - a Height from finished floor to Top of cut out: 400A: 1055mm maximum
 - b Maximum cut-out dimensions: 634mm high, 549mm wide, 250mm deep
 - c Working space in front of cut out: 1000mm minimum.
- B Provide earth cable from cut-out to earthing point outside the building.
- C Cut-outs and meters to be mounted onto meter boards made from chipboard, with pvc spacers to hold board away from wall.

V11.3.8 INSTALLING CT CHAMBER

- A To comply with the Electricity Safety, Quality and Continuity Regulations, a minimum clear working space of 1000mm must be maintained to provide adequate working space in front of both the cable termination and the CT Chamber.
- B Comply with DNO bending radii for the appropriate incoming cable. Comply with DNO requirements for clearances and all other mounting requirements.
- C Provide rounded stranded copper conductors (customers tails) that are long enough to reach the centre of the CT chamber via the top of the chamber. DNO will make the connection to the top of the CT chamber and cut out. Tri-rated cables are not accepted.
- D Where cables are terminating directly onto DNO cut out, the outgoing cables for termination onto the cut out by DNO will either be a single run or double run per phase. Cables to comply with DNO requirements.
- E Ensure that all bonding is in accordance with the PME requirements of BS7671. This must be complete before connection can be made. This will include where applicable: gas, water, structural steel, flow & return of central heating system, lightning conductors (internal and external) and air conditioning systems.
- F Install a main earth conductor that will not be less than half the cross-sectional area of the main phase conductors, up to a maximum of 70mm². Earth conductor must exit the trunking and not pass through the CT Chamber. Terminate only one earth conductor at DNO protected multiple earth (PME) connection.

V11.3.9 METER CABINET INSTALLATION

- A Ensure cabinet is installed and weatherproofed in accordance with DNO requirements.
- B Provide 38mm inlet duct, "hockey stick" arrangement and draw wires to permit future installation of the service cable by the DNO.
- C Terminate LV cables in compliance with DNO requirements.

V11.3.10 IDENTIFICATION

- A Comply with requirements for identification specified in V80 Electrical identification:
 - 1 Equipment Identification Labels: Adhesive film labels with clear protective overlay. For residential meters, provide an additional card holder suitable for printed, weather-resistant card with occupant's name
 - 2 Ensure that DNO/PWN equipment is properly labelled to identify their ownership.

V11.3.11 FIELD QUALITY CONTROL

- A 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 Connect a load of known kilowatt rating, [1.5] kW minimum, to a circuit supplied by metered feeder
 - 2 Turn off circuits supplied by metered feeder and secure them in off condition
 - 3 Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation
 - 4 Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.
- C Electricity metering will be considered defective if it does not pass tests and inspections.
- D Prepare test and inspection reports.

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 performance details and physical sizes of plant and equipment refer to 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 V31: Low Voltage Switchgear
 - 3 V40: Small Power Systems
 - 4 V80: Electrical Identification
 - 5 V81: Earthing and Bonding Systems
 - 6 Y41: Building Management Systems
 - 7 Y50: Electrical Commissioning
 - 8 Y60: Conduit and trunking
 - 9 Y61: LV & ELV Cables
 - 10 Y63: Cable Supports
 - 11 Y65: Electrical Accessories
 - 12 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 Disconnector: Is a mechanical switch which in the 'Open' position, complies with requirements specified for the isolating function. A 'Disconnector' 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-Disconnector: 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-Disconnector' 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: $\geq 50\text{V}$ and $\leq 1000\text{V}$ or 600V between conductors and earth
 - b D.C: 1500V between conductors or 900V between conductors and Earth.
- 6 Extra Low Voltage (ELV):
 - a A.C: $<50\text{V}$
 - b D.C. $<120\text{V}$ 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.

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 $+20^{\circ}\text{C}$)
- 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.

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 60269-1: +A2, BS 88-1: +A2: Low-voltage fuses. General requirements
 - 5 BS EN 60079-31: Explosive atmospheres. Equipment dust ignition protection by enclosure "t"
 - 6 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
 - 7 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
 - 8 BS EN 60529 - Specification for degrees of protection provided by enclosures (IP code)
 - 9 BS EN 60898-1: +A13: Electrical accessories ± Circuit breakers for overcurrent protection for household and similar installations. Circuit-breakers for A.C. operation
 - 10 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
 - 11 BS EN 60947-1+A2: Low-voltage switchgear and controlgear. General rules
 - 12 BS EN 60947-2+A2: Low-voltage switchgear and controlgear. Circuit-breakers
 - 13 BS EN 60947-3+A2: Low-voltage switchgear and controlgear. Switches, disconnectors, switch-disconnectors and fuse-combination units
 - 14 BS EN 60947-4-3: Low-voltage switchgear and controlgear. Contactors and motor-starters. AC semiconductor controllers and contactors for non-motor loads
 - 15 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
 - 16 BS EN 60947-6-1: +A1: Low-voltage switchgear and controlgear. Multiple function equipment. Transfer switching equipment
 - 17 BS EN 60947-7-1: Low-voltage switchgear and controlgear. Ancillary equipment. Terminal blocks for copper conductors
 - 18 BS EN 60947-7-2: Low-voltage switchgear and controlgear. Ancillary equipment. Protective conductor terminal blocks for copper conductors
 - 19 BS EN 60947-7-3: Low-voltage switchgear and controlgear. Ancillary equipment. Safety requirements for fuse terminal blocks

- 20 BS EN 60947-7-4: Low-voltage switchgear and controlgear. Ancillary equipment. PCB terminal blocks for copper conductors
- 21 BS EN 60947-8: +A2: Low-voltage switchgear and controlgear. Control units for built-in thermal protection (PTC) for rotating electrical machines
- 22 BS EN 61008-1: +A11: Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs). General rules
- 23 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
- 24 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
- 25 BS EN 61439-1: Low-voltage switchgear and controlgear assemblies. General rules
- 26 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.

V30.2.8 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

V30.2.9 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.

V30.2.10 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 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 Y41: Building Management Systems
 - 6 Y50: Testing and Commissioning of mechanical and Electrical Services
 - 7 Y60: Conduit and trunking
 - 8 Y61: LV & ELV Cables
 - 9 Y63: Cable Supports
 - 10 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 Protection devices Interposing and inter-tripping relays
 - 5 Voltage sensing relays
 - 6 Trip/close switches and control selector switches
 - 7 Current transformers
 - 8 Instruments and meters
 - 9 Indicator lights
 - 10 Surge Protection
 - 11 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. $< 120\text{V}$ 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°C
 - b Average over 24h: ≤ +35°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
 - 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 requirements:
- 1 LV supply refer to section V11.
- 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

V31.1.6 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.

V31.1.7 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.

V31.1.8 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.

V31.1.9 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: 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 and Outgoing: All MCCBs and Fused switches to be of the "plug-in" type
 - I 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 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 facia of each MCCB tray to enable the future provision of a kw hour meter should the client require this in the future.
- 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 Terminals: Provide tinned copper terminals complete with terminal shields for external conductor, control and auxiliary circuits.
- H 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.
- I 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.
- J 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.
- K Provision for Future Devices: Equip compartments with rails, mounting brackets, supports, necessary appurtenances, and bus connections.
- L 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.
- M 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.
- N Provide Communications module suitable for remote monitoring of meter quantities and functions. Interface communication and metering requirements according to V11 "Low Voltage Connections".
- O Display and Control Units Mounting: flush or semi-flush mounted in instrument compartment door.
- P 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.
- Q 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, 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: 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 and 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
 - 2 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 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.
- E Switches: Select to exhibit excellent trade resistance of isolator material in switch frame (CTV> 600C, BS EN 60112+A1) to prevent flashover between phases.
- F Terminals: Provide tinned copper terminals complete with terminal shields for external conductor, control and auxiliary circuits.
- G Busbars: Comply with the following throughout the switchboards:
- 1 Type: copper
 - 2 Rating:
 - a Sub-main distribution boards: maximum 800A busbar rating.
- H 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.

I 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.

J 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 disconnector
- 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.

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- 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 disconnectors
- 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 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.

V31.2.8 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.

V31.2.9 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.

V31.2.10 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.

V31.2.11 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.

V31.2.12 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 8/20µs: 5 or 10 kA (peak value)
- 6 Maximum discharge current I_{max} 8/20µs: 25 or 40 kA (peak value)
- 7 Limiting discharge current*: 40 kA or 65kA 4/10 µs (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 µs)
- 11 Short-circuit withstand: 3 kA
- 12 Frequency: up to 62 Hz
- 13 Total creepage distance: 62 mm.

V31.2.13 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.

V31.2.14 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.

V31.2.15 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.

V31.2.16 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.

V31.3 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 LV SWITCHBOARDS INSPECTION AND TEST PROCEDURES

- A Install and commission switchgear and control gear 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.

V31.3.5 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.

V31.3.6 CONNECTIONS

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

V31.3.7 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.

V31.3.8 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.

V31.3.9 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.

V40 SMALL POWER SYSTEMS

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V40.3.4	FUSED SPUR CONNECTION UNIT INSTALLATION
V40.3.5	CONNECTIONS TO FIXED APPLIANCES

V40.3.6	INSTALLATION OF HAND DRYERS
V40.3.7	IDENTIFICATION
V40.3.8	FIELD QUALITY CONTROL
V40.3.9	EARTHING
V40.3.10	PROTECTION
V40.3.11	MEASURING MOUNTING HEIGHTS
V40.3.12	COMPONENTS MOUNTING HEIGHTS

V40.1 PART 1 – GENERAL

V40.1.1 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 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 Low Voltage Connection – V11
 - 2 Low Voltage Distribution – V30
 - 3 Low Voltage Switchgear – V31
 - 4 Electrical Identification – V80
 - 5 Earthing and Bonding Systems – V81
 - 6 For Cable Supports – Y63
 - 7 Electrical Accessories – Y65 (lighting switches, telephone & data outlets).

V40.1.2 SUMMARY

- A This Section includes the following:
 - 1 Small Power outlets and accessories for:
 - a Socket outlets
 - b RCD Protected sockets
 - c Filtered Sockets
 - d Round Pin sockets
 - e Key operated switched socket outlets
 - f Three pole fan isolators
 - g Floor outlet boxes
 - h Shaver sockets outlets
 - i Fused connection units and Flex outlets
 - j Key operated switch isolator
 - k Cooker control unit.
 - 2 Floor outlet boxes
 - 3 Electric Heating Units
 - 4 Hand dryers
 - 5 Trace heating for mechanical services.
- B Refer to section Y60 for the following LV equipment:
 - 1 Y60.2.11 Metal Distribution Trunking
 - 2 Y60.2.12 Lighting Trunking
 - 3 Y60.2.13 PVC Distribution Trunking
 - 4 Y60.2.14 Steel Perimeter Trunking Systems
 - 5 Y60.2.15 PVC Perimeter Trunking
 - 6 Y60.2.16 Underfloor Trunking - Flush Lid – No Service Outlets
 - 7 Y60.2.17 Buried “In Screed” Floor Trunking
 - 8 Y60.2.18 Raised Floor Trunking Systems
 - 9 Y60.2.19 Service Outlet Boxes Raised Access Floors
 - 10 Y60.2.20 Service Outlet Boxes for Screeded Floors
 - 11 Y60.2.21 Service Poles & Posts
 - 12 Y60.2.22 Trunking Supports and Fixings.

V40.1.3 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 Medical Location Definitions:
 - a Group 0: Locations where loss of power cannot cause a danger to life
 - b Group 1: Medical equipment is intended to be used but loss of power does not represent a threat to life safety of patient
 - c Group 2: Medical location where medical equipment is intended to be used, and where discontinuity (failure) of the supply can cause danger to life, in applications such as:
 - intracardiac procedures; and
 - vital treatment and surgical operations.
- 3 Clinical risk categories: Refer to HTM 06-01 Part A:
 - a Cat 3: Emergency care and diagnostics- loss of power limited to < 15 s for medical support equipment only
 - b Cat 4: Group 1 (patients in special medical locations) loss of power <15 s (for connected medical equipment), RCD required.
 - c Cat 5: Group 2: Life support or complex surgery – loss of power <0.5s. IPS required & alternative power supply
- 4 IPS: Isolated power Supply also known as Medical IT (Impedance Terra earthed).

B The following acronyms are used in this specification:

- 1 A.C: Alternating Current
- 2 D.C: Direct Current
- 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 Extra Low Voltage (ELV):
 - a A.C: $<50V$
 - b D.C. $<120V$ ripple-free.
- 5 XLPE: Crosslinked Polyethylene
- 6 LSF: Low Smoke and Fume
- 7 ACB: Air Circuit Breaker
- 8 IET: institution of Engineering and Technology
- 9 IP: Ingress Protection to BS EN 60529 and defines protection against solid objects and separately against moisture
- 10 IPS: Isolated Power Supply: A Medical isolation Transformer (IT) device to protect patients in group 2 locations (operating theatres, intensive care, special care baby units) and clinical risk categories 4 & 5 from risks associated with electrical leakage current. In an IPS unit, the outgoing electrical circuits supplying critical care and life support equipment are constantly monitored for short circuits or earth leakage faults. Any fault will result in an audio and visual alarm being raised so that immediate action can be taken by Maintenance Technicians before unexpected loss of electrical power occurs.
- 11 UPS: Uninterruptible Power Supply
- 12 RCD: Residual Current Device to quickly connect current to prevent serious harm to personnel.
- 13 SP: Single Pole
- 14 DP: Double Pole
- 15 TPN: Three Phase and Neutral
- 16 LED: Light-emitting Diode
- 17 PE: Protective Earth
- 18 CE: Clean Earth: This is a low-noise earth and is provided by a conductor separated from the protective earth (PE) and from all extraneous earth paths throughout the distribution system
- 19 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.
- 20 CPC: Circuit Protective Conductor
 21 SSO: Switched socket outlet
 22 SO: Unswitched socket outlet

V40.1.4 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 outlets per m²) for socket outlets and requirements for power supplies to fixed equipment and mechanical services equipment.
- 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 Provide socket outlets as indicated in the specification section B, drawings, room data sheets and schedules of equipment. Generally, socket outlets are to be of the switched type unless indicated otherwise. Always refer to the Architectural schedules and drawings for details of finishes. Where no other requirements are stated or indicated provide general socket outlets of the following types/finishes:
- | | |
|---|--------------------------------------|
| 1 General hotel/ commercial/retail areas: | White PVC recessed |
| 2 Offices with raised floors: | White PVCu within floor outlet boxes |
| 3 Offices without raised floors: | White PVCu within dado trunking |
| 4 Industrial areas: | Metal clad surface mounted |
| 5 Plantrooms: | Metal clad surface mounted |
| 6 Kitchen/food processing: | Stainless steel recessed |
| 7 5A Lighting sockets: | Round three pin white PVCu recessed |
- F In clinical areas all power supply circuits are to be served from two essential supplies in accordance with the guidance in Health Technical Memorandum 06-01 – 'Electrical services supply and distribution' Refer also to IET "A Guide to Electrical Installations in Medical Locations".
- G In general, socket-outlets (as defined by BS 7671) will conform to BS 1363 or IEC harmonised standards and be connected to a ring or radial circuit. The protective device for a single-phase circuit should not exceed:
- a Ring circuit: 32 A
 - b Radial circuit: 20 A.
- H All sockets should be suitable for the local environment to ensure that suitable precautions (IP ratings) are made for sockets in kitchens, laboratories, plantrooms and general circulation spaces.

V40.1.5 SUBMITTALS

- A Shop Drawings: For each type of bus assembly and plug-in device:
- 1 Show fabrication and installation details for enclosed bus assemblies. Include plans, elevations, and sections of components. Designate components and accessories, including clamps, brackets, hanger rods, connectors, straight lengths, and fittings
 - 2 Show fittings, materials, fabrication, and installation methods for listed fire-stop barriers and weather barriers where required
 - 3 Indicate required clearances, method of field assembly, and location and size of each field connection.
 - 4 Detail connections to switchgear, switchboards, transformers, and panel boards
 - 5 Wiring Diagrams: Power and signal and control signal, and control wiring:
 - a Design Calculations
 - b Detail fabrication, including anchorages and attachments to structure and to supported equipment.
- B Shop drawings for switches and socket outlets:
- 1 List of legends and description of materials and process used for pre-marking wall plates.
- C Coordination Drawings: Floor plans and sections, drawn to scale. Include scaled bus-assembly layouts and relationships between components and adjacent structural, mechanical, and electrical elements. Show the following:
- 1 Vertical and horizontal enclosed bus-assembly runs, offsets, and transitions
 - 2 Clearances for access above and to the side of enclosed bus assemblies
 - 3 Vertical elevation of enclosed bus assemblies above the floor or bottom of structure
 - 4 Support locations, type of support, and weight on each support.
 - 5 Location of adjacent construction elements including light fixtures, HVAC and plumbing equipment, fire sprinklers and piping, signal and control devices, and other equipment.
- D Product Certificates: For each type of enclosed bus assembly, and wiring device signed by product manufacturer.
- E Product Data: For each type of product incorporated into the project.
- F Samples: One for each type of device and wall plate specified, in each colour specified. Seek approval from CA to any finishes that could have a visual impact.
- G Field quality-control test reports as required in part 3.
- H Operation and Maintenance Data: For enclosed bus assemblies and all other wiring accessories to include in emergency, operation, and maintenance manuals.

V40.1.6 QUALITY ASSURANCE

- A Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B Electrical Components, Devices, and Accessories: Listed and labelled as defined in relevant British and Local Standards. Comply with the requirements of the IET Wiring Regulations and associated Guidance Notes.
- C 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.
- D Ensure that the whole installation complies with the relevant standards, including the following:
- 1 BS HD 60269-3+A1, BS 88-3: Low-voltage fuses. Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications). Examples of standardized systems of fuses A to F

- 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 1362 - Specification for general purpose fuse links for domestic and similar purposes (primarily for use in plugs)
- 4 BS 1363-2+A4: 13 A plugs, socket-outlets, adaptors and connection units. Specification for 13 A switched and unswitched socket-outlets
- 5 BS 1363-4+A4 - 13 A plugs, socket-outlets and adaptors. Specification for 13A fused connection units switched and unswitched
- 6 BS 4177 - Specification for cooker control units
- 7 BS 4573+A5: Specification for 2-pin reversible plugs and shaver socket-outlets
- 8 BS 4662 + A1: Boxes for flush mounting of electrical accessories. Requirements, test methods and dimensions
- 9 BS 5733: +A1: General requirements for electrical accessories. Specification
- 10 BS 7288 - Specification for socket outlets incorporating residual current devices (R.C.D.s)
- 11 BS 7671+A3: Requirements for Electrical Installations. IET Wiring Regulations
- 12 BS EN 50075: Specification for flat non-wirable two-pole plugs 2.5 A 250 V, with cord, for the connection of class II-equipment for household and similar purposes
- 13 BS EN 50085-1+A1: Cable trunking systems and cable ducting systems for electrical installations. General requirements
- 14 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
- 15 BS EN 60309-2+A2: Plugs, socket-outlets and couplers for industrial purposes. Dimensional interchangeability requirements for pin and contact-tube accessories
- 16 BS EN 60529 - Specification for degrees of protection provided by enclosures (IP code)
- 17 BS EN 60669-1+A2 - Switches for household and similar fixed electrical installations. General requirements
- 18 BS EN 60669-2-4: Switches for household and similar fixed electrical installations. Particular requirements. Isolating switches
- 19 BS EN 60670-1+A1: Boxes and enclosures for electrical accessories for household and similar fixed electrical installations. General requirements
- 20 BS EN 60670-22: Boxes and enclosures for electrical accessories for household and similar fixed electrical installations. Particular requirements for connecting boxes and enclosures
- 21 BS EN 60670-23: Boxes and enclosures for electrical accessories for household and similar fixed electrical installations. Particular requirements for floor boxes and enclosures
- 22 BS EN 60730-2-7 - Specification for automatic electrical controls for household and similar use. Particular requirements. Timers and time switches
- 23 BS EN 60947-3+A2 - Specification for low-voltage switchgear and control gear. Switches, disconnectors, switch-disconnectors and fuse-combination units
- 24 BS EN 61000-6-1: Electromagnetic compatibility (EMC). Generic standards. Immunity for residential, commercial and light-industrial environments
- 25 BS EN 61386-23: +A11: Conduit systems for cable management. Particular requirements. Flexible conduit systems
- 26 BS EN 61439-1: Low voltage switchgear and controlgear assemblies. Particular requirements for busbar trunking systems (busways)
- 27 BS EN 61439-6: Low-voltage switchgear and controlgear assemblies. Busbar trunking systems (busways)
- 28 BS EN 61534-22: Powertrack systems. Particular requirements for powertrack systems intended for onfloor or underfloor installation
- 29 BS EN 61439-1: Low-voltage switchgear and controlgear assemblies. General rules
- 30 BS EN 61543: Residual current-operated protective devices (RCDs) for household and similar use - Electromagnetic compatibility
- 31 BS EN 61558-2-5: Safety of transformers, reactors, power supply units and combinations thereof. Particular requirements and tests for transformer for shavers, power supply units for shavers and shaver supply units

- 32 BS EN 62094-1 - Indicator light units for household and similar fixed-electrical installations. General requirements.
- 33 PSA (MOB PF2 PS): The Property Services Agency (PSA) Method of Building Performance Specification 'Platform Floors (Raised Access Floors)'.

V40.1.7 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.
- B If stored in areas subjected to weather, cover equipment to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside equipment.
- C 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:
- 1 Do not proceed with interruption of electrical service without Contract Administrator's written permission.

V40.1.8 CO-ORDINATION

- A Coordinate layout and installation of components with other elements the construction including HVAC equipment, fire-suppression system, and partition.

V40.1.9 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:
- 1 Each type of wiring device: One for every 20 devices.

V40.2 PART 2 - PRODUCTS

V40.2.1 SMALL POWER GENERAL

- A Always refer to the architectural specification/schedules for confirmation of appropriate finishes for all electrical outlets and accessories.
- B Provide samples to the CA for approval prior to ordering.

V40.2.2 SOCKET OUTLETS

- A Manufacturers: 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 MK Electric
 - 2 Legrand
 - 3 Crabtree
 - 4 Eaton Electric
 - 5 Wandsworth.
- B Construction: Switched or unswitched socket outlets, single or 2 gang design as indicated on the drawings
All socket outlets used on the installations are to be of the same manufacture and match the design of the lighting circuit switches used. Sockets to be 13A, BS1363 rectangular, three pin shuttered switched sockets, single or twin.
- C Construction types: Where necessary the drawings and room data sheets and the architectural drawings and specification indicate the types of sockets to be used which can be of the following types:
 - 1 Type A: Moulded white PVCu/urea formaldehyde plastic front plate
 - 2 Type B: Metalclad Aluminium front plate
 - 3 Type C: Metalclad grey powder coated steel front plate
 - 4 Type D: Blue anti-bacterial PVCu
 - 5 Type E: 5A round pin PVCu/plastic
 - 6 Type F: Stainless steel front plate
 - 7 Type S: Special finish (Refer to architectural drawings and specification for details).
- D Technical Details:
 - 1 Standards:
 - a Rectangular pin: BS 1363
 - b Round pin: BS 546.
 - 2 Voltage rating: 250V A.C.
 - 3 Current rating: 13A
 - 4 IP Rating:
 - a Normal: IP2XD
 - b Weatherproof (WP): IP66.
 - 5 Terminals capacity:
 - a Live, neutral & earth:
 - 3 x 2.5mm²
 - 3 x 4mm²
 - 2 x 6mm² (standard).
 - 6 Safety shutter: 3 pin operated
 - 7 Double pole switching
 - 8 Max installation altitude: 2000m
 - 9 Option: LED indicator (provide where indicated on the drawings).

- E For special purposes provide colour coded sockets as indicated in V40.1.4. Seek approval from CA prior to ordering any sockets.

V40.2.3 RCD PROTECTED SOCKET OUTLETS

- A Application: Provide where indicated on the drawings. These sockets provide a high level of protection against electrocution and give further protection when used with appliances vulnerable to insulation damage, particularly when they are in damp environments or outdoors. The sockets units are not suitable for mounting in damp environments or outdoors or for connection across two lines of a 127V Line to Neutral Voltage System.
- B Technical Details:
- 1 Standards:
 - a EC Directives
 - b Low Voltage Directive
 - c CE marked
 - d RCD DP Single Sockets comply with the requirements of the following standards:
 - BS 7288
 - BS EN 61000-6-1
 - e RCD SP Double Sockets comply with the requirements of
 - BS EN 61543.
 - 2 Rated Voltage: 240V A.C.
 - 3 Current rating: 13A resistive
 - 4 Rated tripping current: 10mA/30mA
 - 5 Terminals capacity:
 - a 3 x 4mm² or 1 gang
 - b 2 x 4mm² for 2 gang.
 - 6 IP rating:
 - a Normal: IP2XD
 - b Weatherproof: IP66
 - 7 Max installation altitude: 2000 metres.
- C RCD sockets to incorporate:
- 1 Re-set mechanism: Active control sensitive to mains failure and prevents automatic re-start on restoration of power
 - 2 Stay set: Passive control which does not trip under power failure.

V40.2.4 FILTERED SOCKET OUTLETS

- A Application: Socket outlets designed to combat interference to, or data losses on, sensitive electrical products and systems due to mains borne voltage spikes and RFI. Such systems include:
- 1 Computer or microprocessor-based equipment
 - 2 Telecommunications systems
 - 3 Electronic measurement equipment
 - 4 Cash registers
 - 5 Audio visual and hi-f equipment.
- B These products to be used where indicated on the drawings, room data sheets and/or schedules of equipment. Fitted with 2-way filtering.
- C Fitted with two earth terminals to provide a double earth facility for use when installations require a high integrity protective connection as specified within the latest edition of BS 7671.

D Filter cassettes are supplied with sockets and have an LED which shows green under normal conditions but will turn red or extinguish when a replacement cassette (1800 kWh) is required. An alarm will also beep at 5 second intervals to indicate replacement necessity. It can be de-activated if required.

E Technical Details:

- 1 Standards:
 - a BS 5733
- 2 Rated Voltage: 240V A.C.
- 3 Current rating:13A
- 4 Earth Leakage: 0.5mA
- 5 Suppression: 150kHz- 30MHz (transients)
- 6 Maximum energy absorption
 - a L-N: 140J
 - b L-E: 140J.
- 7 Terminals capacity
 - a 2 x 6mm²
 - b 3 x 4mm²
 - c 3 x 2.5mm²
 - d 3 x 1.5mm²
- 8 IP rating:
 - a Normal: IP2XD
- 9 Max installation altitude: 2000 metres.

V40.2.5 THREE POLE FAN ISOLATORS

A Application: Three Pole Fan Isolators provide a safe and simple method of isolating mechanical fan units and is particularly useful in bathrooms, toilets, storerooms and basements where there is little or no natural light. For example, timer-controlled fans are often linked into the lighting circuit for energy saving and convenience. In such an installation there is often a need for the lighting circuit to remain live to provide light whilst the fan unit is externally isolated so that routine maintenance and repairs can be carried out in complete safety.

B The fan isolator can be used as a double pole or triple pole isolator. It includes a clear on/off indicator and the frontplate features a fan isolator symbol for easy circuit identification.

C Technical Details:

- 1 Standards:
 - a BS EN 60669-2-4
- 2 Rated Voltage: 240V A.C.
- 3 Current rating:10A
- 4 Rated conditional short circuit current: 3000A
- 5 Terminals capacity
 - a 4 x 1mm²
 - b 4 x 1.5mm²
 - c 3 x 2.5mm²
 - d 2 x 4mm²
 - e 1 x 6mm²
- 6 IP rating:
 - a Normal: IP4X
- 7 Max installation altitude: 2000 metres.

V40.2.6 SHAVER SOCKET OUTLETS

- A Application: For shaver/toothbrush supply units in residential and hotel type accommodation. May be used in bathrooms and washrooms.
- B Features: Accommodates the following international plug types:
- 1 British 5mm dia pins on 16.6mm pitch (230V socket) to BS 4573
 - 2 European 4mm dia pins on 17 to 19mm pitch (230V socket) to BS EN 50075
 - 3 Australian 6.5 x 1.6 fat blades each set at 30° to the vertical on a nominal pitch of 13.7mm (230V socket) AS/NZS 3112:2000
 - 4 American 6.6 x 1.6 fat horizontal blades on 12.7mm pitch (115V socket) to UL498 / NEMA WD6.
- C Technical Details:
- 1 Standards:
 - a BS EN 61558-2-5
 - 2 Rated Voltage:
 - a 230V A.C. Input (operates at 220-250Va.c.)
 - b 127V A.C. Input (operates at 110-130Va.c.)
 - 3 Current rating:
 - a 200mA or
 - b 400mA
 - 4 Maximum Load: 20VA
 - 5 Terminals capacity
 - a 1 x 4mm²
 - b 2 x 2.5mm²
 - 6 IP rating:
 - a Normal: IP41
 - 7 Max installation altitude: 2000 metres

V40.2.7 FUSED CONNECTION UNITS AND FLEX OUTLETS

- A Application: 13A fused connection units and 20A DP switches designed for the connection of refrigerators, water heaters, central heating boilers and other fixed appliances.
- B Neon indicators: Provide products with Neon indicators included in the rockers of the switched connection units, integrally wired into the product and which do not require separate connection when installing. The design to give 175° visibility in the horizontal and vertical planes.
- C Fuse carriers: Captive type and opened by a fast acting, screwdriver operated worm drive for ease of replacement. A tamper-proof version is also available for specific applications including schools, prisons, police stations and mental health units.
- D Flex outlets: Bottom outlet types with blanking plug allowing use where the bottom outlet is not required. The products are equipped with very strong, push-fit nylon cord grip.
- E Flex outlet plate: An unfused flex outlet with cord grip and 3 pairs of terminals.
- F Technical Details:
- 1 Standards:
 - a Connection units: BS 1363-4
 - b 20A DP Switches: BS EN 60669-1
 - c Flex outlets: BS EN 60670-22
 - d Fuses: BS 1362
 - 2 Rated Voltage:
 - a 250V A.C.
 - 3 Current rating:

- a Connection units: 13A
- b DP Switches: 20A
- c Flex Outlets: 20A
- 4 Terminals capacity (supply and load each)
 - a 2 x 6mm² stranded
 - b 2 x 4mm²
 - c 3 x 2.5mm²
- 5 IP rating:
 - a With flex outlet: IP2XD
 - b Without flex outlet: IP4X
- 6 Max installation altitude: 2000 metres

V40.2.8 KEY OPERATED SWITCH ISOLATOR

- A 20A key operated fire alarm isolator is intended for use with building alarm systems that are required to comply with BS 5839 Part 1. The built-in lock ensures power cannot be provided without the key being operated, making it safe to carry out maintenance to fire alarms.
- B Technical Details:
 - 1 Standards:
 - a Isolators: BS 60669-2-4
 - 2 Rated Voltage:
 - a 250V A.C.
 - 3 Current rating:
 - a Isolator: 20A
 - 4 Terminals capacity (Live, earth & neutral)
 - a 2 x 6mm²
 - b 3 x 4mm²
 - c 3 x 2.5mm²
 - 5 IP rating:
 - a With flex outlet: IP2XD
 - 6 Max installation altitude: 2000 metres

V40.2.9 HIGH CURRENT SWITCHES AND COOKER CONTROL UNITS

- A Application: Switches and cooker control units suitable for the switching of all domestic, commercial and industrial appliances where higher current ratings are required, i.e. cookers, heaters, units etc.
- B Features:
 - 1 Double Pole switches
 - 2 Cooker Control units: Incorporates a cooker control unit DP switch (isolator) and a socket outlet only if indicated. Note that the most safe/preferred installation is without the socket outlet
 - 3 Cooker Connection Units: Cable wall outlet plate from cooker control unit.
- C Technical Details:
 - 1 Standards:
 - a DP Switches: BS EN 60669-1
 - b Cooker Control units: BS 4177 (incorporates single 13A switched socket outlet)
 - c Cooker Connection units: BS EN 60670-22 (outlet plate for cooker cable).
 - 2 Rated Voltage:
 - a 250V A.C.
 - 3 Current rating:
 - a Switch: 32A
 - b Cooker Control Units: 45A

- c Cooker Connection units: 45A
- d Switch (resistive load): 50A
- 4 Terminals capacity (50A switches, cooker control and connection units)
 - a 4 x 4mm²
 - b 3 x 6mm²
 - c 1 x 10mm²
 - d 1 x 16mm²
- 5 Terminal Capacity, 32A Switch
 - a 3 x 2.5mm²
 - b 2 x 4mm²
 - c 1 x 6mm²
 - d 3 x 2.5mm²
- 6 IP rating:
 - a Cooker Control Units: IP2XD
 - b 32A, 50A Switches, cooker connection unit: IP4X
- 7 Max installation altitude: 2000 metres.

V40.2.10 RAISED FLOOR OUTLET BOXES

- A Application: Raised Access Floor service boxes provide a housing for power, data and telecom socket outlets to service workstations within a cavity floor installation. Provide floor outlet boxes as indicated in the drawings and specification/room datasheets. Boxes to be complete with the number and type of outlets indicated.
- B Provide boxes complete with dividers to configure the number of compartments. Boxes to have reversible self-closing lid, snap in retainer guides and suitable for heavy duty steel galvanised conduit (BS EN 61386-23) and CAT 6 compliant design.
- C 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 Marshall-tufflex
 - 4 Schneider
 - 5 Cableduct
- D Construction:
 - 1 Casing: galvanised sheet steel
 - 2 Loading limits: PSA MOB PF2 PS medium grade specification minimum
 - 3 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.
 - 4 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.
 - 5 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.
- 6 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.
- 7 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.
- E All floor outlet boxes shall be capable of, installation from above the floor panel.
- F Compartments: Modular, interchangeable and allow for the arrangement of all components as shown on the drawings. Provide knockouts on each compartment end and in the sidewalls to allow facility for inter-wiring between modular compartment boxes.
- G Lids: Hinged with stainless steel, retractable lifting handle and be reinforced with a 4mm steel plate finished with a plastic moulding. Provide with recess of sufficient depth to match floor finish. Refer to the Architect's schedule of finishes. Incorporate a position control to allow easy closing or vertical parking.
- H Cable outlets; Provide sponge filled, opening cable outlets along with cable retainers in the boxes.
- I Box trims: Unless indicated otherwise provide as follows and submit samples to CA for approval before ordering:
 - 1 Back of house areas: Plastic trim
 - 2 Office areas: Plastic Trim
 - 3 Public areas: Brushed stainless steel.
- J Supply boxes prewired with 3 metre long flexible metallic conduit for power wiring.
- K Refer to layout drawings for details of cast in, recessed or slab mounted floor outlet boxes.
- L Floor panels to be supplied with pre-cut holes for installation of floor boxes. Co-ordinate installation with floor specialist contractor.

V40.2.11 EXTERNAL SOCKET OUTLET PITS

- A Provide external power outlet pits where indicated on the layout drawings as manufactured by GIFAS Electric their 'Retrant' design. Each floor pit to comprise:
 - 1 2No.16A BS EN 60309-2+A2 socket outlets.
 - 2 lockable non-slip cover: stainless steel
 - 3 Water resistant when in the closed position: IP65
 - 4 BS EN 124 Loading classification: 15Kn.

V40.2.12 ELECTRIC HEATING

- A For electric heaters specification and type EH refer to section T30.2.27:
 - 1 EH1 – Electric Radiant Panel Heaters (500W – 2000W)

- 2 EH2 – Electric convector Heaters (500W -3000W)
- 3 EH3 – Tubular heaters (60 or 80W/300mm up to 2100mm)
- 4 EH4 – Towel Rails (120W-350W)
- 5 EH5 – Low Surface Temperature Radiators Heaters (775W-1550W).

V40.2.13 HAND DRYER AIR BLADE TYPE

A Surface mounted blade type high speed, heater free type as manufactured by Dyson their Airblade dB type or approved equivalent:

- 1 Technical details:
 - a Input voltage/Frequency: 200-240V 50Hz
 - b Rated power: 1600 W
 - c Motor type: Dyson digital motor V4 – brushless DC Motor
 - d Motor switching rate: 6,000 per second
 - e Motor speed: 90,000 rpm
 - f Operating temperature range: 0°– 40°C
 - g Heater type: None
 - h Standby power consumption: Less than 0.5 W.
- 2 Construction:
 - a Casing construction: Polycarbonate-ABS casing
 - b Antibacterial coating type: Contains antibacterial moulded additive in fascia
 - c and blades. Can help prevent the growth of bacteria.
 - d Colour finish: Grey or White
 - e Light reflective value: 28.3 (grey) 77.4 (white)
 - f Galvanised steel back plate/mounting bracket
 - g Exterior screw type: Anti-tamper M6 machine screw
 - h Water ingress protection to IP35.
- 3 Filter:
 - a HEPA filter (glass fibre and fleece prelayer)
 - b Bacteria removal 99.9%.
- 4 Operation:
 - a Touch-free infra-red activation
 - b Hand dry time measurement: 10 seconds.
 - c (Measurement based on National Sanitation Foundation Protocol P.335)
 - d Operation lock-out period: 30 seconds
 - e Airspeed at apertures: 690 km/h (430 mph)
 - f Operating airflow: Up to 35 l/s.
- 5 Dimensions:
 - a Height: 661mm
 - b Width: 303mm
 - c Depth: 247mm.
 - d Mounting height to bottom of unit above finished floor level:
 - Male: 390mm
 - Female: 315mm
 - Child/disabled: 215mm.

V40.2.14 HAND DRYER COMPACT DOWNFLOW TYPE

A Surface mounted compact high speed, heater free type with 500W motor as manufactured by Excel Dryer Inc their Xlerator type or approved equivalent:

- 1 10-15 seconds drying time
- 2 Motor:
 - a 220V/50Hz

- b 500 W.
 - c 20,000 rpm.
- 3 Casing: Die cast zinc/stainless steel with one of the following finishes: Refer to Architectural details for suitable finishes:
 - a Chrome coated or
 - b Brushed stainless steel or
 - c White painted
 - d Graphite painted.
- 4 Temperature 57°C
- 5 Dimensions: L 298mm X H 322mm X D 170mm
- 6 Noise Level: 76 dBA (with noise reducing nozzle)
- 7 IP Rating 23
- 8 Mounting heights: To underside of units above finished floor level:
 - a Men: 1140mm
 - b Women: 1090mm
 - c Children: 890mm
 - d Disabled: 940mm.
- 9 Controls:
 - a PIR sensor next to outlet
 - b Adjustable speed & sound control.

V40.2.15 TRACE HEATING

- A This includes trace heating for frost protection and also for temperature maintenance.
- B Refer to specification section Y30, particularly Y30.1.8, Y30.2.10 and Y30.3.22 for performance requirements, product types and installation instructions.

V40.3 PART 3 - EXECUTION

V40.3.1 EXAMINATION

- A Do not begin installation until substrates have been properly prepared.
- 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.

V40.3.2 INSTALLATION GENERAL

- A Install all equipment in accordance with manufacturer's instructions.
- B Comply with the BS7671+A2 Electrical Wiring Regulations and associated Guidance Notes.
- C Coordination with Other Trades:
 - 1 Take steps to ensure that components are protected. Do not place wall finish materials over components and do not cut holes for boxes with routers that are guided by riding against outside of the boxes
 - 2 Keep outlet components 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 components 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.
- D 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.
- E Device Installation:
 - 1 All components 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 component 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 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
 - 6 Use a torque screwdriver when a torque is recommended or required by the manufacturer
 - 7 Tighten unused terminal screws on the device.
- F Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.
- G Where equipment is provided with an internal uninterruptible power supply or other power source (power storage capacitors, external generators, batteries etc.) clear signage warning of the dangers shall be provided at all points of isolation for the equipment both as a part of the fixed electrical installation and

internal isolation within the equipment. The signage shall also indicate the source and nature of the risk, capacitor, battery, generator etc. and any time delay between switch-off and the equipment becoming safe.

V40.3.3 INSTALLATION OF SOCKET OUTLETS

- A 13 A, 230V socket outlets shall be provided as indicated on drawings and shall have two pole and earthing to BS 1363.
- B 13 A, 230V socket outlets for connection to equipment that is supported by UPS shall be to standard pattern and engraved with 'UPS Supported'. UPS supported socket outlets shall not be provided with RCD protection as standard.
- C Weatherproof socket outlets shall be provided with a push-on cap and cap retaining ring.
- D Socket outlets shall be mounted in flush metal boxes complete with an earthing terminal. Socket outlets must be provided with an earthing terminal and earth tag to connect the socket outlet to the metal box. Where surface mounted socket outlets are required, they shall be of the flush pattern, mounted on suitable adapter boxes.
- E Plugs shall be provided with all socket-outlets and handed over to the Employer's representative.
- F Where metal cover plates are specified as a metal type (not metalclad) the cover plate shall be fabricated from solid metal. All accessories shall be fitted to adjustable grids over lapping standard BS 4662 boxes.
- G All general power 230V socket outlets shall be provided with 30mA RCD protection by means of a combined RCD/MCB unit in the distribution board. The unit shall preferably be a single module width device. However, if the contractor proposes to use a 2-module width device he shall increase the distribution board size and rearrange the distribution board schedules in order to achieve the same circuiting and phasing shown on the distribution board schedules.
- H Socket outlets within floorboxes that are supplied via busbar systems shall have local RCD protection i.e. the RCD is not installed at the distribution board.

V40.3.4 FUSED SPUR CONNECTION UNIT INSTALLATION

- A Fused Spur units are to be of the 13A AC rating combining a double pole switch, a single pole fuse in the live line and a pilot light for confirmation that the unit is turned on.
- B Fused spur outlets for connection to equipment that is supported by UPS shall additionally be engraved with 'UPS Supported'.
- C All wall mounted spur units, with the exception of those to be installed in plant rooms and concealed spaces shall be of the flush type with front plates either all insulated, or metal as detailed elsewhere in this specification. Spur units are to be mounted on flush metal boxes. Where surface spur units are to be used, they shall be mounted on either metal or plastic purpose-made mounting boxes to be of the same material as that of the front plates.
- D In plantrooms, spur points shall be of the surface mounted type and shall be metal clad.
- E Where metal cover plates are specified as a metal type (not metalclad) the cover plate shall be fabricated from solid metal. All accessories shall be fitted to adjustable grids over lapping standard BS 4662 boxes.

V40.3.5 CONNECTIONS TO FIXED APPLIANCES

- A Final connections to this type of equipment to be carried out by using either an insulated copper high temperature PVC sheathed cable or a flexible metallic conduit with heat resisting cables run through the conduit.
- B Provide a double pole isolator adjacent to each fixed appliance. Conduit for kitchen equipment shall not be run in the floor screed with the exception of kitchens which have island units.

- C Final connections made using flexible conduit are to comprise, a metallic flexible conduit covered with continuous PVC sheath and shall comply with Y60 "Conduit and Trunking". Sufficient length shall be allowed for vibration and movement of the equipment. A separate circuit protective conductor wire must be run inside the conduit.

V40.3.6 INSTALLATION OF HAND DRYERS

- A Install in accordance with manufacturer's instructions.
- B Install dryers at specified heights.
- C Install dryers securely to supporting substrate so that fixtures are level and aligned with each other. Use type and length of fastener as recommended by manufacturer for type of substrate.
- D Inspect installation to verify secure and proper mounting. Test each dryer to verify operation, control functions, and performance. Correct deficiencies.
- E Protect installed dryers until completion of project.
- F Replace damaged products before practical completion.

V40.3.7 IDENTIFICATION

- A Comply with V80 "Electrical Identification".

V40.3.8 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.

V40.3.9 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.

V40.3.10 PROTECTION

- A Ensure there is no physical or electrical damage to components when they are removed from their packaging and during installation.
- B Provide masking covers for surface mounted to protect surface from paint.
- C Where components are flush mounted install front plate after painting is finished.

V40.3.11 MEASURING MOUNTING HEIGHTS

- A Take measurement for position of components 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.
- B Mount equipment below a worktop 100mm below underside of worktop.

V40.3.12 COMPONENTS MOUNTING HEIGHTS

- A Mounting heights shall be as the centreline below unless otherwise specified, see Y65 "Electrical Accessories".

V50 GENERAL LIGHTING SYSTEMS

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V50.1 PART 1 - GENERAL

V50.1.1 RELATED DOCUMENTS

- A For drawings and general provisions of the Contract refer to the main Contract Preliminaries and Section A of this specification.
- B Supply install test and commission the complete lighting installation in accordance with the drawings and specification.
- C Supply all luminaires, lamps, lighting trunking and accessories as indicated on the drawings and schedules of equipment.
- D For system description of operation and lighting design parameters refer to section B of this specification and the Schedules of Equipment.
- E Related Sections which may form part of section C of this specification.
- 1 V51: Automatic Lighting Controls
 - 2 V55: Self-contained Emergency and Signage Systems
 - 3 V56: Central battery Emergency and Signage Systems
 - 4 V57: Static Inverter Emergency and Signage Systems
 - 5 V59: General Luminaires and Lamps
 - 6 V60: External Lighting Systems
 - 7 V80: Electrical Identification
 - 8 Y60: Conduit and Trunking
 - 9 Y61: LV and ELV Cables
 - 10 Y63: Cable Supports
 - 11 Y65: Electrical Accessories
- F Refer to Y65 for the following lighting system accessories:
- 1 Switchplates
 - 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 Modular Lighting Connectors
 - 8 Plug-In Sockets and Ceiling Roses
 - 9 Luminaire Ceiling Roses and Pendants
 - 10 Lamp Holders
 - 11 Dimmer Switches (Low Voltage)
 - 12 Time Switches
 - 13 Isolating Switches
- G For automatic lighting control systems comply with section V51 which takes precedence. Where V51 has not been issued comply with the minimum control requirements indicated in this section.

V50.1.2 SUMMARY

- A The section includes the requirements for general lighting systems including
- 1 Performance requirements
 - 2 Technical Submittals
 - 3 Lighting system components
 - 4 Lighting fixture supports.
 - 5 Connection to luminaires

6 Installation requirements

V50.1.3 DEFINITIONS

A The following Acronyms are used in this specification:

- 1 CIBSE: Chartered Institution of Building Services Engineers
- 2 Circuit Watt: power consumed in lighting circuits by the lamps and where applicable their associated control gear.
- 3 LENI: Lighting Energy Numeric Indicator. It's a measure of the total amount of energy used by the lighting, divided by the useful floor space per annum (kWh/m²/year)
- 4 L/Cw: Lamp lumens per circuit watt
- 5 LL/cW: Luminaire lumens per Circuit Watt. (lamp lumens x LOR/ Circuit Watts = LL/cW)
- 6 LOR: Light Output ratio. Ratio of the total light output to that of the lamp/s contained in the luminaire.
- 7 PIR: Passive infra-red
- 8 SLL: Society of Light and Lighting
- 9 UGR: Unified Glare rating
- 10 BF: Ballast factor.
- 11 CCT: Correlated colour temperature.
- 12 CRI: Colour-rendering index.
- 13 HID: High-intensity discharge.
- 14 LER: Luminaire efficacy rating.
- 15 Lumen: Measured output of lamp and luminaire, or both.
- 16 Luminaire: Complete lighting fixture, including ballast housing if provided.

B For the definition of parameters used in the specification for lighting design criteria refer to BS EN 12665

V50.1.4 PERFORMANCE REQUIREMENTS

A Refer to the drawings, schedules of luminaires and specification section B for the scope of works, method of operation of the systems and selection of luminaires.

B All lighting installations are to meet the requirements of the current CIBSE lighting guidelines and the Building Regulations. The choice of energy saving light fittings is paramount when selecting luminaires for the projects. Use good practice and the guidance in most recent editions of:

- 1 SLL Code for Lighting
- 2 SLL Lighting Handbook

C Cost effective energy savings should be considered at design stage, the use of PIR presence detectors, photocells and time switches should be employed wherever possible. The requirements for lighting control are indicated in section B, Room Data sheet Schedule B2 and section Y51 of this specification. The aim of the lighting scheme is to:

- 1 Provide an attractive, fit-for-purpose environment for building users in terms of lighting levels, lighting quality, flexibility and (where feasible) user control;
- 2 Exhibit high energy efficiency and low maintenance costs in use;
- 3 Achieve the shortest payback period consistent with the above.
- 4 Minimize projected whole-life costs including installation, energy consumption and maintenance, within affordability constraints.
- 5 Comply with the project specific BREEAM requirements (refer to section B).

D Wherever possible the use of natural daylight should be used to light the building however all buildings will require artificial lighting at night as well as during the day when natural light levels are too low. Choose the most efficient lamps and luminaries as indicated by their lumen output per watt and every effort should be made to standardise on lamp type and wattage during the detailed design stage.

E For specific applications use the design guidance in the following SLL Lighting Guides where applicable:

- 1 SLL No. 1: The Industrial Environment
- 2 SLL No. 2: Hospitals and Health Care Buildings
- 3 SLL No. 4: Sports
- 4 SLL No. 5: Lighting for Education
- 5 SLL No. 6: The Exterior Environment
- 6 SLL No. 7: Offices
- 7 SLL No. 8: Lighting for museums and Art galleries
- 8 SLL No. 9: Lighting for Communal Residential Buildings
- 9 SLL No. 10: Daylighting – A guide for designers
- 10 SLL No. 11: Surface Reflectance and Colour
- 11 SLL No. 12: Emergency Lighting
- 12 SLL No. 13: Lighting for Places of Worship
- 13 SLL No. 14: Control of Electric Lighting
- 14 SLL No. 15: Transport Buildings
- 15 SLL No. 16: Lighting for Stairs

F Lighting Efficiency: Lighting design and installation of fittings must conform to the following:

- 1 Building Regulations: Building Regulations L2A for new buildings or 2B for existing buildings
- 2 Comply with the Non-Domestic Building Services Compliance Guide (NDCG) Table 42. Typical minimum lighting efficacy standards are as follows and may be reduced depending upon controls employed:
 - a General lighting in offices, industrial and storage areas: 60LL/cW
 - b General Lighting in other spaces: 60 LL/cW
 - c Display lighting: 22 LL/cW
- OR**
- 3 Demonstrate the overall efficiency of the installation using the Lighting Energy Numerical Indicator LENI as per BS EN 15193. (For maximum target consumption refer to Table 44 on the NDCG). When calculating the LENI make allowance for the following:
 - a Parasitic energy use (Ep): With control system $E_p = 0.3W/m^2$ during hours of use
 - b Power of Lighting (Pl): Total luminaire consumption in Watts
 - c Occupancy Factor (Fo): With auto controls presence detection switching $F_o = 0.80$
 - d Daylight Factor (Fd): With daylight linked dimming $F_d = 0.8$ within 6m of a window wall or 10% rooflights
 - e Constant illuminance factor (Fc): Where lighting levels are controlled to reduce excess illumination and energy consumption, $F_c = 0.9$.
 - f Determine energy use:
 - daytime energy use (Ed) = $(Pl \times F_o \times F_d \times F_c \times T_d) \div 1000$ kWh
 - night time energy use (En) = $(Pl \times F_o \times F_d \times F_c \times T_d) \div 1000$ kWh
 - Calculate LENI: = $(E_p + E_d + E_n) \div A$ kWh/m² (where A is the area covered by the lighting installation)
 - Check compliance with target value. (Table 44 of NDCG)
- 4 Calculate the average power lighting density which should not exceed 1.8 W/m²/100 lux

G For general internal illumination in offices and similar spaces, use LED technology unless indicated otherwise in the schedules and drawings.

H **Lamps:** All lamps should be of a high quality, from named manufacturers and possess a minimum rated life of 20,000 hours, or 35,000 to 50,000 hours in restricted access areas e.g. high ceilings.

I **Luminaires:** Comply with the following:

- 1 Design and manufacture to BS EN 60598.
- 2 light output ratio (LOR): $\geq 80\%$.
- 3 Standards: CE approved.
- 4 Electronic ballasts warranty: minimum 1-year Parts & Labour.

J

Lighting Control Systems: The specific control requirements are usually indicated in section B and Y51 but if nothing is stated provide the following minimum. Design Lighting controls to control, where appropriate, all the lighting in the building. Where projects are being assessed under BREEAM, cognisance of BREEAM requirements must be taken and design the control of luminaires to meet the requirements of this scheme.

- 1 The lighting controls should be easily maintained without the need for operatives to interrogate/access a centralised control unit or front-end PC.
- 2 Provide for each group of luminaires equipment which includes: -
 - a PIR presence/absence detectors to control banks or groups of fittings; the coverage of which should be designed in accordance with manufacturers' recommendations.
 - b Local momentary override switch for each bank or group of fittings controlled by presence detectors.
 - c Daylight sensors to control banks or groups of fittings along each elevation
- 3 Agree the mode of operation with the CA and configure as follows unless alternative control strategies are indicated elsewhere. If provided the alternative strategies are paramount:-
- 4 **Circulation areas:**
 - a Arrange the system in each section so that the luminaires served by the lighting control installation are switched on automatically when a person enters a circulation area
 - b Ensure that the luminaires remain on until the accommodation served from the circulation area has been vacated or until the control installation senses that adequate light is being received from outside.
 - c Generally LED light sources are to be used in these areas.
 - d Arrange the system so that the time lapse between an area being vacated and the "off" signal being given can be set from 1-20 minutes.
- 5 **Offices:**
 - a **Presence detection:** One or more sensors initiate automatic illumination when presence is detected.
 - b **Absence detection:** One or more sensors initiate the automatic reduction in illumination of a controlled area after a time of non-occupancy.
 - c Arrange the system such that the time lapse between an area being vacated and the "off" signal being given can be set from 1-20 minutes.
 - d Arrange the system to automatically vary the output of the luminaires serving a group of workstations to maintain a constant lighting level on the working plane.
 - e Ensure that the level of illumination can be adjusted to suit a change of use.
 - f Arrange the controls to allow manual override of the lighting level via a wall switch to allow increase or decrease in the level.
 - g Arrange for the controls to revert to a set level each time the luminaires are switched on.
 - h Arrange for the lighting controls to switch the row of luminaires adjacent to external elevations detecting a high daylight contribution internally.
- 6 **Toilets:**
 - a Arrange the system to bring the luminaires into operation when a person is present and there is insufficient natural light.
 - b Arrange the system such that the time lapse between an area being vacated and the "off" signal being given can be set from 1-20 minutes.
- 7 **Plant rooms and IT Rooms**
 - a Provide manual switching.

K

Final connections to luminaires shall be in accordance with this specification.

L

Electromagnetic Compatibility:

- 1 Ensure all cabling and containment are installed to provide electromagnetic compatibility within the systems and are fully compatible with all other electrical, electronic and radio frequency installations in the same location.

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V50.1.5 SUBMITTALS

- A Product Data: provide manufacturer's data sheets for each type of product intended to be incorporated into the design. Include data on features, accessories, finishes, and physical description of component including the following:
- 1 Materials and physical description of luminaires including dimensions.
 - 2 Manufacturer's certified data for each luminaire to include the following to BS EN 13032-2:
 - a Light source
 - b Power consumption
 - c Photometric data showing
 - Total lamp flux: kL
 - Normalised Intensity table showing flux at various angles
 - Polar Intensity diagram
 - LOR, DLOR, ULOR
 - SHR (spacing to height ratio)
 - Unified Glare Rating
 - d Colour temperature
 - e Colour Rendering Index
 - f Median useful life
 - g Driver details
 - h Dimming
 - i Method of mounting
 - 3 Manufacturer's certified data for each Emergency lighting luminaire to include the following to BS EN 13032-3
 - a Light source
 - b Power consumption
 - c Spacing tables
- B Energy performance: Provide for each discrete part of the lighting installation the assessment of the
- 1 Efficacy of lighting and controls and compare to Table 42 of NDCG
or
 - 2 LENI and compare to table 44 of NDGC
 - 3 Power density of lighting expressed in $W/m^2/100$ lux
- C Lighting Calculations: Where calculations are specified in section B to be carried out or where alternative (from specified) luminaires are proposed provide a technical submittal that demonstrates that the average illuminance, uniformity and unified glare rating can be achieved. Use industry stand design tools such as Dialux. Unless indicated otherwise in section B or in the architectural specifications and drawings use the following design parameters in the calculations:
- 1 Maintenance Factor: 0.67
 - 2 Room reflectances:
 - a Ceiling: 70%
 - b Walls: 50%
 - c Floor: 20%
- D Installation and Wiring Drawings: Submit installation drawings of the lighting system, as intended to be supplied, including schematic diagrams, luminaire types, coverage patterns, interconnection diagrams showing field-installed controls and physical dimensions of each item and method of fixing into the building fabric.
- E Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.
- 1 Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.

- 2 Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3 For networked controls: System schematic diagram showing the components of the system and their locations and equipment references. The schematic is to include the following where provided:
 - a GUI
 - b Server
 - c System floor Controllers/Routers
 - d Lighting Control relay modules
 - e Dimmer controls
 - f DALI devices
 - g Touch panels
 - h Sensors
 - 4 Reflected ceiling plan(s) and other plans/details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - a Luminaires (with type references)
 - b Occupancy sensors
 - c Photo sensors
 - d Wall mounted lighting control switch plates
 - e Other HVAC equipment (grilles diffusers,)
 - f Fire alarm and detection equipment
 - g Other items in finished ceiling including the following:
 - Speakers
 - Sprinklers
 - Access panels.
- F Field quality-control reports.
- G Operation and Maintenance Data: For lighting system components and fixtures for incorporation into the operation, and maintenance manuals.
- H Warranty: Sample of special warranty.

V50.1.6 QUALITY ASSURANCE

- A Ensure that the design, construction, materials and finishes of all components are suitable for the location, climatic and operating conditions to which the installation will be exposed.
- B Ensure that the whole installation complies with the relevant standards, including the following:
- 1 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)
 - 2 BS 5489-1: Code of practice for the design of road lighting. Lighting of roads and public amenity areas
 - 3 BS 7671+A3 - Requirements for electrical installations. IET Wiring Regulations. Eighteenth edition
 - 4 BS EN 12464-1: Light and lighting. Lighting of workplaces. Indoor workplaces
 - 5 BS EN 12665: Light and lighting - Basic terms and criteria for specifying lighting requirements
 - 6 BS EN 13032-1+A1 - Lamps and lighting. Measurement and presentation of photometric data of lamps and luminaires. Measurement and file format.
 - 7 BS EN 13032-2: Light and lighting. Measurement and presentation of photometric data of lamps and luminaires. Presentation of data for indoor and outdoor workplaces
 - 8 BS EN 13032-3: Measurement and presentation of photometric data of lamps and luminaires. Presentation of data for emergency lighting of workplaces
 - 9 BS EN 15193-1: Energy performance of buildings. Energy requirements for lighting. Specifications, Module M9
 - 10 BS EN 60079-15
 - 11 BS EN 60529 - Specification for degrees of protection provided by enclosures (IP code)
 - 12 BS EN 60570 - Electrical supply track systems for luminaires

- 13 BS EN 60598-1: Luminaires. General requirements and tests
- 14 BS EN 60598-2-1: Luminaires. Particular requirements. Specification for fixed general purpose luminaires
- 15 BS EN 60598-2-2: Luminaires. Particular requirements. Recessed luminaires
- 16 BS EN 60598-2-3: Luminaires. Particular requirements. Luminaires for road and street lighting
- 17 BS EN 60598-2-5: Luminaires. Particular requirements. Floodlights
- 18 BS EN 60598-2-6: Luminaires. Particular requirements. Luminaires with built-in transformers for filament lamps
- 19 BS EN 60598-2-22: Luminaires. Particular requirements. Luminaires for emergency lighting
- 20 BS EN 60598-2-23: Luminaires. Particular requirements. Extra low voltage lighting systems for filament lamps
- 21 BS EN 60598-2-24: Luminaires. Particular requirements. Luminaires with limited surface temperatures
- 22 BE EN 61140: Protection against electric shock. Common aspects for installation and equipment
- 23 BS EN 62262 - Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
- 24 ISO 7000/IEC 60417: Graphical symbols for use on equipment
- 25 CIBSE/SLL Code for Interior Lighting
- 26 CIBSE/SLL Lighting Guides.
- 27 Non-domestic Building Services Compliance Guide

- C Electrical Components, Devices, and Accessories: Listed and labelled as defined in IET regulations by a qualified testing agency and marked for intended location and application.
- D Mock-ups: Provide interior lighting system mock-ups for room or module mock-ups, complete with power and control connections:
 - 1 Obtain Architect's approval of fixtures for mock-ups before starting installations
 - 2 Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed work
 - 3 Approved fixtures in mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

V50.1.7 CO-ORDINATION

- A Coordinate layout and installation of lighting system components and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.
- B Check all ceiling heights to ensure that the specified luminaires can be mounted at the correct height to achieve the design illuminance without adversely affecting the occupation of the space.

V50.2 PART 2 – PRODUCTS

V50.2.1 MANUFACTURERS

A Products: Subject to compliance with requirements in section A & B provide products indicated in equipment schedules of the specification and drawings that form part of this specification. Where manufacturers are not named suitable manufacturers are:

- 1 Trilux
- 2 Thorlux
- 3 Erco
- 4 Zumtobel
- 5 Philips
- 6 iGuzzini

V50.2.2 PROTECTION MEASURES

A **Against Electric Shock:** Ensure that luminaires are provided with the appropriate protection against touch sensitive voltages in accordance with BS EN 61140 and marked with symbols in compliance with ISO 7000/IEC 60417.

- 1 **Class I:** Luminaire is designed for connection to a protective conductor. Protection class I is not identified by a symbol. The symbol indicating the protective earth is to be used. Unless specified otherwise, all luminaires to comply at least with protection class I.
- 2 **Class II:** Luminaires have total insulation but no protective earth terminal. This typically includes moisture proof batten luminaires and moisture-proof diffuser luminaires.
- 3 **Class III:** Luminaires that are intended for operation with protective extra low voltage (50 V max.).

B **Against ingress of solid object, dust and moisture:** Ensure that all luminaires have the appropriate Ingress of Protection in accordance with BS EN 60529. Comply with the requirements in section B but where nothing is indicated comply with the following minimum standards:

- 1 IP20: most general purpose interior luminaires
- 2 IP44: street lighting and basic bollards and floodlights.
- 3 IP65: outdoor lighting in public areas and for professional floodlighting
- 4 IP67: luminaire that can be immersed in water under defined conditions.
- 5 IP68: underwater luminaires.

C **Against mechanical shock:** Where luminaires need extra resistance against impact/abuse provide the appropriate protection against impact in accordance with (IK code). BS EN 62262. Where nothing is indicated in section B comply with the following minimum standards.

IK Rating	Potential Risk	Application
IK07	No major risk of impact	Plantrooms/Technical Rooms
IK08	Significant risk of impact that could damage lighting equipment	Circulation spaces
IK10	High risk of impact that might damage lighting equipment	Underpasses, subways, Workshops, schools,
IK16 (extrapolated from BS)	Vandal resistant high impact resistance	Prisons, sporting halls and gymnasias

D **Safety Distances:** Ensure that high intensity luminaires are installed more than the minimum distance from the luminaire to the illuminated surface to avoid excessive temperatures.

V50.2.3 GENERAL REQUIREMENTS FOR LIGHTING SYSTEM COMPONENTS

- A For details of luminaires and lamps refer to V59 and the schedule of equipment section D of this specification.
- B Supply luminaires in accordance with the following standards;
- 1 Fixed General purpose luminaires: BS EN 60598-2-1
 - 2 Recessed luminaires: BS EN 60598-2-2
 - 3 Luminaires for road and street lighting: BS EN 60598-2-3 and BS 5489-1.
 - a Supply luminaires with type N protection in accordance with BS EN 60079-15
 - 4 Floodlights to BS EN 60598-2-5.
 - a Supply luminaires with type N protection in accordance with BS EN 60079-15
 - 5 Luminaires with built-in transformers for filament lamps: BS EN 60598-2-6.
 - 6 Extra low voltage lighting systems for filament lamps: BS EN 60598-2-23.
 - 7 Luminaires with limited surface temperature: BS EN 60598-2-24.
 - 8 Electrical supply track systems for luminaires: BS EN 60570.
 - 9 Classification: BS EN 60598-1
 - 10 Emergency luminaires: BS EN 60598-22
 - 11 CE marked
- C Safety features:
- a Ensure that metal parts are free of burrs and sharp corners and edges.
 - b Provide secondary means of support for diffusers, gear trays, reflectors and translucent covers to prevent them fall when their fixings are released.
- D For ceiling roses and other lighting accessories refer to Y65

V50.2.4 LIGHTING FIXTURE SUPPORT COMPONENTS

- A Conduit: Refer to Y60
- 1 Use not less than 20mm conduit of same type as main conduit system
 - 2 Material - steel.
- B Rod Refer to Y60
- 1 Use continuously threaded rods with matching washers and nuts
 - 2 Diameter - 6mm
 - 3 Material - Cadmium plated steel.
- C Chain:
- 1 Use cadmium plated steel chain with load carrying capacity of not less than twice weight of complete luminaire.
- D Flexible Cord:
- 1 Use size and type as indicated
 - 2 Confirm temperature rating is suitable for operating temperature of luminaire or lamp holder. Confirm that cord is adequate for mass to be supported.
- E Wall Brackets:
- 1 Provide wall brackets. Confirm wall brackets are suitable for supporting luminaire.
- F Ball and Socket:
- 1 Provide ball and socket as top support, complete with cover fixed to circular conduit box.

V50.3 PART 3 – EXECUTION

V50.3.1 INSTALLATION

- A **Temporary Lighting:** If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- B Installation in Potentially Explosive Atmospheres: Comply with BS EN 60079-14.
- C **Ceiling mounted luminaires:** Ensure that system is compatible with the ceiling systems specified in the architectural specifications. Provide independent supports where luminaires are mounted on, or recessed into, the ceiling systems. Luminaires must not rely on the ceiling system for support.
- 1 Ensure suspension system allows adjustment to follow the line and level of the ceiling
 - 2 Ensure that luminaires do not adversely affect the fire integrity/performance of the ceiling system
 - 3 Modular luminaires: ensure they are compatible with the ceiling module and type of grid
 - 4 Recessed rows of luminaires: provide flanges for the support of the grid and any infill units. Provide lateral restraints where necessary.
 - 5 Provide a means of access for maintenance of luminaires
- D **Lay-in Ceiling Lighting:**
- 1 Do not use ceiling grid as a support element:
 - 2 Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 150 mm from lighting fixture corners
 - 3 Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are suitable for the application
 - 4 Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or centre in acoustical panel, and support fixtures independently with at least two 20-mm metal channels spanning and secured to ceiling tees
 - 5 Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- E **Suspended Lighting Fixtures:**
- 1 Pendants and Rods: Where longer than 1200 mm brace to limit swinging
 - 2 Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers
 - 3 Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end
 - 4 Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- F **Wall mounted luminaires:** Unless indicated otherwise install wall mounted luminaires at a height of 1900mm above finished floor level.
- G Connect wiring according to Y61 LV and ELV Cables.
- H For fixing to the building structure comply with the requirements in specification section Y90. Seek approval from the CA for all luminaire supports and fixings.

V50.3.2 SUPPORTS

- A Ensure support is adequate for weight of luminaires.
- B Provide the following minimum number of supports for each luminaire longer than 600mm:

Luminaire width (mm)	Minimum number of supports
Up to and including 300	2
Over 300	4

C From Conduit:

- 1 Where luminaire is supported from conduit provide a conduit box forming an integral part of conduit system at each point of suspension. Ensure suspensions are vertical
- 2 Where conduit enters luminaire use back-nuts and washers to secure luminaire body to conduit support. Provide tube with corrosion resistance equal to conduit system
- 3 Do not support luminaires directly from conduit boxes made from non-metal or heat sensitive materials, where the temperature of the material may exceed 60°C or the mass suspended exceeds 3kg.

D From Trunking:

- 1 Where luminaire is supported from trunking use proprietary clamps or brackets appropriate to the luminaire and trunking
- 2 Do not support luminaires directly from trunking made from non-metal or heat sensitive materials, where the temperature of the material may exceed 60°C or the mass suspended exceeds 3kg.

E By Direct Fixing:

- 1 Refer to fixing methods, use luminaire supporting coupler in accordance with BS 7001 or follow manufacturer's recommendations.

F In Suspended Ceiling:

- 1 Support luminaires independently directly from building fabric.

V50.3.3 SUSPENSIONS

A Suspend luminaires at height indicated. Ensure suspensions hang vertically unless otherwise indicated.

- 1 By Rod:
 - a Use washers, nut and lock-nut at top and bottom of rod. Paint cut ends with calcium plumbate primer or zinc rich paint.
- 2 By Chain:
 - a Use hook cover for suspension from circular conduit box. For connection to luminaires use luminaire manufacturer's own chain hook, but if not available use hook with standard screw threaded body to be secured to luminaire body with nuts and washers. Where indicated use captive hooks.
- 3 By Flexible Cord:
 - a Suspend cord from ceiling rose.
- 4 By Ball and Socket:
 - a Install cable through ball and socket connected to conduit box.

V50.3.4 CONNECTIONS TO LUMINAIRES

A Cable Protection - Use appropriate size of grommet where cables enter through hole in luminaire body.

B Ensure that the earthing terminal of Class 1 luminaires is connected to the conduit protective conductor of the supply circuit.

C Clip or tie back with suitable proprietary devices loose wiring within luminaire, at 300mm intervals.

D Direct to Conduit - Terminal Box:

- 1 Terminate circuit wiring in terminal block within supporting conduit box. Use flexible cord from terminal block to luminaire.

E Direct to Conduit - at Luminaire:

- 1 Terminate circuit wiring at supply terminals of luminaire. Take all conductors through same cable entry into luminaire.
- F Direct to Trunking - Terminal Box:
- 1 Terminate circuit wiring in terminal block in an adaptable box located on side of trunking. Use flexible cord from terminal block to luminaire.
- G Direct to Trunking - at Luminaire:
- 1 Terminate circuit wiring at supply terminals of luminaire. Take all conductors through same cable entry into luminaire.
- H Suspended from Trunking:
- 1 Where luminaires are suspended from trunking, secure plug and socket in accordance with BS 546, adjacent to, or on side of, trunking. Terminate circuit wiring at socket. Take flexible cord from plug of ceiling rose to supply terminals of luminaire.
- I Recessed Fittings - Plug and Socket:
- 1 Where luminaires are recessed in a suspended ceiling, terminate circuit wiring at plug and socket in accordance with BS 546, located not more than 500mm from the access through the ceiling. Use flexible cord from plug of ceiling rose to supply terminals of luminaire.
- J Recessed Fittings - Terminal Box:
- 1 Where luminaires are recessed in a suspended ceiling, terminate circuit wiring in terminal block within conduit box. Install wiring to luminaire as indicated in wiring diagram.
- K Conduit Suspension:
- 1 Terminate circuit wiring in terminal block within supporting conduit box. Use flexible cable from terminal block to luminaire, installed within tube.
- L Rod or Chain Suspension:
- 1 Terminate circuit wiring in terminal block within supporting conduit box. Use flexible cord from terminal block to luminaire and clip cable to one of the rods or chains, do not weave cable through links of the chain.
- M MICS Cable:
- 1 Fix cable gland to luminaire and continue conductors to supply terminals of luminaire.

V50.3.5 LIGHTING SWITCHES ON DIFFERENT PHASES

- A When installing lighting switches on different phases ensure that they are at least 2m apart unless fitted with at phase barrier.
- B Phase Barrier: When lighting switches on different phases are in a common box, use phase barrier switches in accordance with IET wiring regulations.

V50.3.6 IDENTIFICATION

- A Comply with requirements for identification specified in V80 Electrical Identification.

V50.3.7 FIELD QUALITY CONTROL

- A Handle, store and install equipment and components of the lighting system in accordance with the manufacturer's recommendations.
- B Obtain all equipment and components from a single source, unless otherwise specified.

- C Inspect all equipment and components on delivery, before fixing and after installation, and reject and replace any that are defective.

V50.3.8 TESTING AND COMMISSIONING

- A For all areas of the building record the illuminance levels, uniformity and glare and check that they are in compliance with the standards indicated in section B, or where not provided, in accordance with the performance requirements indicated in Part 1 of this specification section.
- B Commission the systems in accordance with CIBSE commissioning code part L
- C Demonstrate to the Employer and record the operation of the control systems. Confirm compliance with the requirements of this specification.
- D Arrange for all tests and demonstrations to be witnessed by the commissioning management contractor in accordance with Y50 of this specification
- E Submit all test results to the CA for comment/approval.
- F Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark:
 - 1 Adjust aimable luminaires in the presence of the CA.

V50.3.9 HANDOVER DOCUMENTATION

- A Provide Operation and maintenance information for luminaires and lighting system components

V55 SELF-CONTAINED EMERGENCY AND SIGNAGE SYSTEMS

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V55.1 PART 1 – GENERAL

V55.1.1 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 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 Comply with the lighting design illuminance levels indicated in section B of this specification.
- E Refer also to the following sections:
 - 1 V50 "General Lighting Systems"
 - 2 V51 "Automatic Lighting Controls"
 - 3 V56 "Central battery Emergency and Signage Systems"
 - 4 V57 "Static Inverter Emergency and Signage Systems"
 - 5 V59 "General Luminaires and Lamps"
 - 6 V60 "External Lighting Systems"
 - 7 V69 "Specialist Luminaires and Lamps"
 - 8 V80 "Electrical Identification"
 - 9 V81 "Earthing and Bonding Systems"
 - 10 V85 "Electrical Testing and Inspection".
- F Where relevant this document is to be read in conjunction with the following:
 - 1 For Building Monitoring and Management – Y41
 - 2 For Electrical Commissioning – Y50
 - 3 For Conduit and Trunking – Y60
 - 4 For LV and ELV Cables – Y61
 - 5 For Cable Supports – Y63
 - 6 For fixing to Building – Y90.

V55.1.2 SUMMARY

- A Section Includes:
 - 1 Interior lighting fixtures, lamps, and ballasts
 - 2 Emergency lighting units
 - 3 Exit signs
 - 4 Lighting fixture supports.

V55.1.3 DEFINITIONS

- A BF: Ballast factor.
- B CCT: Correlated colour temperature.
- C CRI: Colour-rendering index.
- D HID: High-intensity discharge.
- E LER: Luminaire efficacy rating.
- F Lumen: Measured output of lamp and luminaire, or both.
- G Luminaire: Complete lighting fixture, including ballast housing if provided.

V55.1.4 PERFORMANCE REQUIREMENTS

- A Final connections to luminaires shall be in accordance with this specification.
- B Check all ceiling heights to ensure that the specified luminaires shall be mounted at the correct height to the bottom of the fittings.
- C Electromagnetic Compatibility:
 - 1 Ensure all equipment and systems are installed to provide electromagnetic compatibility within the systems and are fully compatible with all other electrical, electronic and radio frequency installations in the same location.
- D 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%.
- E For system operating conditions, temperatures and working pressures refer to section B of this specification.

V55.1.5 SUBMITTALS

- A Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1 Physical description of lighting fixture including dimensions
 - 2 Emergency lighting units including battery and charger
 - 3 Ballast, including BF
 - 4 Energy-efficiency data
 - 5 Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps
 - 6 Photometric data and adjustment factors based on laboratory tests, complying with BS EN 13032 and BS 4533 which part some superseded for each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project:
 - a Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer
 - b Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation.
- B Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work:
 - 1 Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection
 - 2 Wiring Diagrams: For power, signal, and control wiring.
- C Samples: For each lighting fixture indicated in the Interior Lighting Fixture Schedule. Each Sample shall include the following:
 - 1 Lamps and ballasts, installed
 - 2 Cords and plugs
 - 3 Pendant support system.
- D Installation instructions.
- E Co-ordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1 Lighting fixtures
 - 2 Suspended ceiling components
 - 3 Partitions and millwork that penetrate the ceiling or extends to within 305 mm of the plane of the luminaires

- 4 Ceiling-mounted projectors
 - 5 Structural members to which suspension systems for lighting fixtures will be attached
 - 6 Other items in finished ceiling including the following:
 - a Air outlets and inlets
 - b Speakers
 - c Sprinklers
 - d Smoke and fire detectors
 - e Occupancy sensors
 - f Access panels.
 - 7 Perimeter mouldings.
- F Qualification Data: For qualified agencies providing photometric data for lighting fixtures.
- G Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.
- H Field quality-control reports.
- I Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals:
- 1 Provide a list of all lamp types used on Project; use classifications ANSI and manufacturers' codes.
- J Warranty: Sample of special warranty.

V55.1.6 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 will be exposed.
- B Ensure that the whole installation complies with the relevant standards, including the following:
- 1 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)
 - 2 BS 559 - Specification for the design and construction of signs for publicity, decorative and general purposes
 - 3 BS 1362 - Specification for general purpose fuse links for domestic and similar purposes (primarily for use in plugs)
 - 4 BS 1853-2 - Tubular fluorescent lamps for general lighting service. Specification for lamps used in the United Kingdom not included in BS EN 60081, BS EN 60901, BS EN 61195 and BS EN 61199
 - 5 BS ISO 3864-1 Graphical symbols. Safety colours and safety signs. Design principles for safety signs and safety markings
 - 6 BS 7671+A2 - Requirements for electrical installations. IEE Wiring Regulations. Seventeenth edition
 - 7 BS 7693 - Guide to uses of infra-red transmission and the prevention or control of interference between systems
 - 8 BS 7895 - Specification for bayonet lamp holders with enhanced safety
 - 9 BS EN 40 - Lighting Columns
 - 10 BS EN 13032-1+A1 - Lamps and lighting. Measurement and presentation of photometric data of lamps and luminaires. Measurement and file format
 - 11 BS EN 50107-1 - Signs and luminous-discharge-tube installations operating from a no-load rated output voltage exceeding 1 kV but not exceeding 10 kV
 - 12 BS EN 55015 - Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
 - 13 BS EN 60061-1+A48 - Specification for lamp caps and holders together with gauges for the control of inter-changeability and safety. Lamps caps
 - 14 BS EN 60061-2+A45 - Specification for lamp caps and holders together with gauges for the control of inter-changeability and safety. Lamp holders

- 15 BS EN 60064+A5 - Tungsten filament lamps for domestic and similar general lighting purposes. Performance requirements
- 16 BS EN 60079 - Electrical apparatus for explosive gas atmospheres
- 17 BS EN 60079-14 - Electrical apparatus for explosive gas atmospheres. Electrical installations in hazardous areas (other than mines)
- 18 BS EN 60081+A4 - Double-capped fluorescent lamps. Performance specifications
- 19 BS EN 60188 - High-pressure mercury vapour lamps. Performance specifications
- 20 BS EN 60192 - Low pressure sodium vapour lamps. Performance specification
- 21 BS EN 60357+A3 - Tungsten-halogen lamps (non-vehicle). Performance specifications
- 22 BS EN 60432-1+A2 - Safety specification for incandescent lamps. Tungsten filament lamps for domestic and similar general lighting purposes
- 23 BS EN 60432-2+A2 - Safety specification for incandescent lamps. Tungsten halogen lamps for domestic and similar general lighting purposes
- 24 BS EN 60529 - Specification for degrees of protection provided by enclosures (IP code)
- 25 BS EN 60570 - Electrical supply track systems for luminaires
- 26 BS EN 60598 - Luminaires
- 27 BS EN 60598-1 - Luminaires. General requirements and tests
- 28 BS EN 60598-2-22+A2 - Luminaires. Particular requirements. Luminaires for emergency lighting
- 29 BS EN 60630+A6 - Maximum lamp outlines for incandescent lamps
- 30 BS EN 60730-2-3 - Specification for automatic electrical controls for household and similar use. Particular requirements. Thermal protectors for ballasts for tubular fluorescent lamps
- 31 BS EN 60901+A5 - Specification for single-capped fluorescent lamps. Performance specifications
- 32 BS EN 60921 - Specification for ballasts for tubular fluorescent lamps. Performance requirements
- 33 BS EN 60923 - Auxiliaries for lamps. Ballasts for discharge lamps (excluding tubular fluorescent lamps). Performance requirements
- 34 BS EN 60925 - Specification for performance requirements for D.C. supplied electronic ballasts for tubular fluorescent lamps
- 35 BS EN 60927 - Specification for auxiliaries for lamps. Starting devices (other than glow starters). Performance requirements
- 36 BS EN 60929 - Specification for A.C. supplied electronic ballasts for tubular fluorescent lamps. Performance requirements
- 37 BS EN 60968 - Specification for self-ballasted lamps for general lighting services. Safety requirements
- 38 BS EN 60969 - Self-ballasted lamps for general lighting services. Performance requirements
- 39 BS EN 61047 - Specification for D.C. or A.C. supplied electronic step-down convertors for filament lamps. Performance requirements
- 40 BS EN 61048 - Specification for capacitors for use in tubular fluorescent and other discharge lamp circuits. General and safety requirements
- 41 BS EN 61049 - Specification for capacitors for use in tubular fluorescent and other discharge lamp circuits. Performance requirements
- 42 BS EN 61050 - Specification for transformers for tubular discharge lamps having a no-load output voltage exceeding 1000 V (generally called neon-transformers). General and safety requirements
- 43 BS EN 61195+A1 - Double-capped fluorescent lamps. Safety specifications
- 44 BS EN 61347-2-1+A1 - Lamp control gear. Particular requirements for starting devices (other than glow starters)
- 45 BS EN 61347-2-2 - Lamp control gear. Particular requirements for D.C. or A.C. supplied electronic step-down convertors for filament lamps
- 46 BS EN 61347-2-3 - Lamp control gear. Particular requirements for A.C. supplied electronic ballasts for fluorescent lamps
- 47 BS EN 61347-2-4 - Lamp control gear. Particular requirements for D.C. supplied electronic ballasts for general lighting
- 48 BS EN 61347-2-5 - Lamp control gear. Particular requirements for D.C. supplied electronic ballasts for public transport lighting
- 49 BS EN 61347-2-6 - Lamp control gear. Particular requirements for D.C. supplied electronic ballasts for aircraft lighting

- 50 BS EN 61347-2-7 - Lamp control gear. Particular requirements for D.C. supplied electronic ballasts for emergency lighting
- 51 BS EN 61347-2-8+A1 - Lamp control gear. Particular requirements for ballasts for fluorescent lamps
- 52 BS EN 61347-2-9 - Lamp control gear. Particular requirements for ballasts for discharge lamps (excluding fluorescent lamps)
- 53 BS EN 61547 - Specification for equipment for general lighting purposes. EMC immunity requirements
- 54 BS EN 61549+A3 - Miscellaneous lamps
- 55 BS EN 62035+A2 - Discharge lamps (excluding fluorescent lamps). Safety specifications
- 56 BS EN 62262 - Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (Ik code)
- 57 ICEL1001 - Luminaire Registration Scheme
- 58 CIBSE Lighting Guides
- 59 BRE IP 9/97 – Emergency Lighting and wayfinding systems for visually impaired people.
- 60 IEC/PAS 62717 Performance requirements – LED modules for general lighting
- 61 IEC/PAS 62722 Performance requirements – LED luminaires for general lighting.

- C Ensure that the whole emergency lighting installation complies with the relevant standards, including the following BS7671.
- D Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are nationally accredited.
- E Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated.
- F Electrical Components, Devices, and Accessories: Listed and labelled as defined in IEE regulations by a qualified testing agency and marked for intended location and application.
- G Lighting fixtures for hazardous locations shall be listed and labelled for indicated class and division of hazard in accordance with BS EN 60079.
- H Mock-ups: Provide interior lighting fixtures for room or module mock-ups, complete with power and control connections.
- I Obtain Architect's approval of fixtures for mock-ups before starting installations.
- J Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed Work.
- K Approved fixtures in mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

V55.1.7 DELIVERY, STORAGE, AND HANDLING

- A Deliver luminaires in sections of lengths that can be moved past obstructions in delivery path.
- B Store luminaires indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- C If stored in areas subjected to weather, cover luminaires to provide protection from weather, dirt, dust, corrosive substances, and physical damage.
- D Installation Pathway: Review Architects drawings and Structural engineer's drawings to understand pathway for moving large luminaires into place.
- E 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.
- F Do not proceed with interruption of electrical service without Contract Administrator's written permission.

V55.1.8 CO-ORDINATION

- A Co-ordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

V55.1.9 WARRANTY

- A Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period:
- 1 Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years
 - 2 Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: 7 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

V55.1.10 EXTRA MATERIALS

- A Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents:
- 1 Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type
 - 2 Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type
 - 3 Fluorescent-fixture-mounted, emergency battery pack: One for every 50 emergency lighting unit
 - 4 Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type
 - 5 Globes and Guards: Furnish at least one of each type.

V55.2 PART 2 - PRODUCTS

V55.2.1 MANUFACTURERS

- A Products: Subject to compliance with requirements: provide products indicated in equipment schedules and drawings that form part of this specification.

V55.2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A Recessed Fixtures: Ensure that fittings are compatible with the ceiling systems specified in the architectural specifications.
- B Incandescent Fixtures: Should not normally be used.
- C Metal Parts: Free of burrs and sharp corners and edges.
- D Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- E Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position.
- F Diffusers and Globes:
- 1 Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation:
 - a Lens Thickness: At least 3 mm minimum unless otherwise indicated
 - b UV stabilized.
 - 2 Glass: Annealed crystal glass unless otherwise indicated.
- G Factory-Applied Labels: Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place:
- 1 Label shall include the following lamp and ballast characteristics:
 - a "USE ONLY" and include specific lamp type
 - b Lamp diameter code, tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires
 - c Lamp type, wattage, bulb type and coating (clear or coated) for HID luminaires
 - d Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires
 - e Ballast type for HID luminaires
 - f CCT and CRI for all luminaires.
- H Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic interference as required by BS EN 61547. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.
- I Air-Handling Fluorescent Fixtures: See V50 and V59.

V55.2.3 LUMINAIRES

- A General Purpose
- B Standards:
- 1 Supply luminaires with photometric data in accordance with BS EN 13032-1+A1
 - 2 Supply luminaires in accordance with BS EN 60598.
- C Classification - in accordance with BS EN 60598-1.

- D Provide secondary support for translucent covers, diffusers and gear trays so they are prevented from falling when their primary fixing is released.
- E Ensure luminaires of similar type have same photometric performance as published data within the tolerances defined by BS EN 13032-1+A1.
- F Ensure luminaires comply with BS EN 61547 for electromagnetic compatibility (EMC) immunity.
- G Physical protection - in accordance with BS EN 62262 (IK) or in accordance with BS EN 60529 (IP).
- H Where safety glass specified, fit luminaire with cover glass to protect against ultra-violet emission and risk from explosion of lamps
- I Special Applications:
- J Standards:
 - 1 Supply luminaires with photometric data in accordance with BS EN 13032-1+A1
 - 2 Supply luminaires in accordance with BS EN 60598.
- K Classification - in accordance with BS EN 60598-1.
- L Ensure luminaires comply with BS EN 61547 for electromagnetic compatibility (EMC) immunity.
- M Physical protection - in accordance with BS EN 62262 (IK) or in accordance with BS EN 60529 (IP).

V55.2.4 EMERGENCY LIGHTING LUMINAIRES

- A Comply with BS EN 60598-2-22+A2.
- B Comply with ICEL 1001. Ensure emergency lighting luminaires are marked with ICEL/CE certification label.

V55.2.5 TYPES OF LAMPS

- A Refer to Schedule of Luminaires for application of lamp types.
- B Tungsten Filament:
 - 1 Comply with BS EN 60064+A5, BS EN 60432-1+A2 and BS EN 60630+A6. Supply electronic step-down converters for filament lamps in accordance with BS EN 61047 and BS EN 61347-2-2. Comply with BS EN 61549+A3 for double capped and ELV lamps.
- C Fluorescent:
 - 1 Internationally specified tubular fluorescent lamps in accordance with BS EN 60081+A4
 - 2 UK tubular fluorescent lamps in accordance with BS 1853-2
 - 3 Single capped fluorescent lamps in accordance with BS EN 60901+A5 Double capped fluorescent lamps in accordance with BS EN 60081+A4
 - 4 Self-ballasted lamps in accordance with BS EN 60969 and BS EN 60968.
- D Tungsten Halogen:
 - 1 Comply with BS EN 60432-2+A2 or BS EN 60357+A3.
- E High Pressure Mercury Vapour:
 - 1 Comply with BS EN 60188 and BS EN 62035+A2.
- F Metal Halide:
 - 1 Comply with BS EN 62035+A2 where appropriate.
- G High Pressure Sodium Vapour:
 - 1 Comply with BS EN 60662 and BS EN 62035+A2.

H Low Pressure Sodium Vapour:

1 Comply with BS EN 60192 and BS EN 62035+A2.

I Manufacturer:

1 Ensure that lamps of each type are from same manufacturer.

V55.2.6 INTERFERENCE

A Comply with BS EN 55015.

V55.2.7 REMOTE GEAR

A Locate control gear in separate lockable cabinet of sheet steel with same degree of protection and finish specified for luminaire.

V55.2.8 EMERGENCY LIGHTING SYSTEMS GENERAL

A Emergency lighting systems shall be of the category (maintained or non-maintained), duration and nominal operating voltages, powered by generator or secondary batteries or have self-contained luminaires, as indicated.

B Emergency exit signage shall be of the Local Municipality control requirements.

C Luminaires shall be manufactured fully in accordance with this specification.

D Select from the following types as indicated on the Luminaire Schedule.

V55.2.9 SELF CONTAINED SYSTEMS

A Unless otherwise stated a self-contained emergency lighting installation will have a 3 hour full emergency design output duration.

B Integral battery chargers will be capable of charging the batteries to full output within a twelve-hour period of completion of a full discharge test.

C Where no central automated test facility is installed the contractor shall provide a key switch operated test facility either local to each lighting circuit or adjacent to the distribution board. The manual test facility shall only disconnect the permanent feed to allow the normal operation of non-emergency luminaires during the test period.

D Where remote emergency battery packs are used the interconnecting cable to the emergency luminaire shall not exceed 1.5m.

E The cabling system for the self-contained emergency lighting system shall match the lighting system distribution.

V55.2.10 AUTOMATED CENTRAL TEST FACILITY

A The central test facility shall be capable of providing automated tests and printed records of all fault, alarm, tests, lamp failures and battery conditions. The system must meet the full requirements of the standards noted in this section.

B Each emergency luminaire shall be individually addressed as noted on the contract drawings, specification and schedules.

C The Test facility panel shall be programmed to take account of the building occupancy periods to enable tests to be scheduled for times suitable to the building occupier.

V55.2.11 CONNECTIONS TO LUMINAIRES

- A Cable Protection - Use appropriate size of grommet where cables enter through hole in luminaire body.
- B Ensure that the earthing terminal of Class 1 luminaires is connected to the conduit protective conductor of the supply circuit.
- C Clip or tie back with suitable proprietary devices loose wiring within luminaire, at 300mm intervals.
- D Direct to Conduit - Terminal Box:
1 Terminate circuit wiring in terminal block within supporting conduit box. Use flexible cord from terminal block to luminaire.
- E Direct to Conduit - at Luminaire:
1 Terminate circuit wiring at supply terminals of luminaire. Take all conductors through same cable entry into luminaire.
- F Direct to Trunking - Terminal Box:
1 Terminate circuit wiring in terminal block in an adaptable box located on side of trunking. Use flexible cord from terminal block to luminaire.
- G Direct to Trunking - at Luminaire:
1 Terminate circuit wiring at supply terminals of luminaire. Take all conductors through same cable entry into luminaire.
- H Suspended from Trunking:
1 Where luminaires are suspended from trunking, secure plug and socket in accordance with BS 546, adjacent to, or on side of, trunking. Terminate circuit wiring at socket. Take flexible cord from plug of ceiling rose to supply terminals of luminaire.
- I Recessed Fittings - Plug and Socket:
1 Where luminaires are recessed in a suspended ceiling, terminate circuit wiring at plug and socket in accordance with BS 546, located not more than 500mm from the access through the ceiling. Use flexible cord from plug of ceiling rose to supply terminals of luminaire.
- J Recessed Fittings - Terminal Box:
1 Where luminaires are recessed in a suspended ceiling, terminate circuit wiring in terminal block within conduit box. Install wiring to luminaire as indicated in wiring diagram.
- K Conduit Suspension:
1 Terminate circuit wiring in terminal block within supporting conduit box. Use flexible cable from terminal block to luminaire, installed within tube.
- L Rod or Chain Suspension:
1 Terminate circuit wiring in terminal block within supporting conduit box. Use flexible cord from terminal block to luminaire and clip cable to one of the rods or chains, do not weave cable through links of the chain.
- M MICS Cable:
1 Fix cable gland to luminaire and continue conductors to supply terminals of luminaire.

V55.2.12 LIGHTING SWITCHES ON DIFFERENT PHASES

- A Separate: Install lighting switches on different phases at least 2m apart.

- B Phase Barrier: -When lighting switches on different phases are in a common box, use phase barrier switches in accordance with local wiring regulations.

V55.3 PART 3 - EXECUTION

V55.3.1 INSTALLATION

- A Lighting fixtures:
- 1 Set level, plumb, and square with ceilings and walls unless otherwise indicated
 - 2 Install lamps in each luminaire.
- B Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.
- D Material of Supporting Surface: Ensure classification of luminaires is appropriate. Do not mount luminaires on readily flammable surfaces.
- E Installation in Potentially Explosive Atmospheres: Comply with BS EN 60079-14.
- F Install luminaires in areas with infra-red control systems or data bearers so as to cause minimum disturbance to the infra-red transmission system in accordance with BS 7693.
- G Signs and High-Voltage Installation: Comply with BS 559 and BS EN 50107-1.
- H Extra Low Voltage Tungsten Halogen Lamps: Use same wattage lamp on luminaires fed from common transformer. Supply each luminaire on common transformer by separate cable of same cross-sectional area.
- I Lay-in Ceiling Lighting Fixtures Supports: Do not use ceiling grid as a support element:
- 1 Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 150 mm from lighting fixture corners
 - 2 Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are suitable for the application
 - 3 Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or centre in acoustical panel, and support fixtures independently with at least two 20-mm metal channels spanning and secured to ceiling tees
 - 4 Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- J Suspended Lighting Fixture Support:
- 1 Pendants and Rods: Where longer than 1200 mm brace to limit swinging
 - 2 Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers
 - 3 Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end
 - 4 Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- K Air-Handling Lighting Fixtures: Install with dampers open and ready for adjustment.
- L Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

V55.3.2 IDENTIFICATION

- A Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

V55.3.3 FIELD QUALITY CONTROL

- A Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.
- C Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

V55.3.4 STARTUP SERVICE

- A Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

V55.3.5 ADJUSTING

- A Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark:
 - 1 Adjust aimable luminaires in the presence of Architect.

V59 GENERAL LUMINAIRES AND LAMPS

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V59.1 PART 1 - GENERAL

V59.1.1 RELATED DOCUMENTS

- A Drawings and general provisions of the Contract, including main Contract Preliminaries and section A of this specification.
- B Supply install test and commission a complete lighting installation in accordance with the drawings and specification.
- C Supply all LV cables, trunking, conduit, wiring etc as indicated on the drawings and Schedules of Equipment.
- D For system operating pressures and temperatures refer to section B of this specification and the Schedules of Equipment.
- E Comply with the lighting design illuminance levels indicated in section B of this specification.
- F Related Sections:
 - 1 V50 "General Lighting Systems"
 - 2 V51 "Automatic Lighting Controls"
 - 3 V55 "Self-contained Emergency and Signage Systems"
 - 4 V60 "External Lighting Systems"
 - 5 V69 "Specialist Luminaires and Lamps"
 - 6 V80 "Electrical Identification"
 - 7 V81 "Earthing and Bonding Systems"
 - 8 V85 "Electrical Testing and Inspection"
 - 9 Y60 "Conduit and Trunking"
 - 10 Y61 "LV and ELV Cables"
 - 11 Y63 "Cable Supports"
 - 12 Y65 "Electrical Accessories"
 - 13 Y67 "Transient Overvoltage Surge Suppression Devices"
 - 14 Y90 "Fixing to Building".

V59.1.2 SUMMARY

- A This section of the specification relates to the works associated with the internal and external lighting design (where required), supply, install and commissioning of the luminaires and lamps.
- B Work includes providing all luminaires and lamps, materials, equipment, accessories, calculations and tests necessary to complete the installation as indicated on the drawings and within the specifications and make ready for operation by the Owner.
- C The requirements include for all fixings, installation, testing, commissioning, 12 months maintenance and demonstration of the lighting and associated systems.
- D Provide controls, power supplies, containment systems and raceways for all luminaires as required by V50 General Lighting Systems, V51 Automatic Lighting Controls and V60 External Lighting Systems.
- E The luminaire and lamp manufacturers shall provide equipment on a design, supply and commission basis with the installation being undertaken by the Electrical Contractor.

V59.1.3 DEFINITIONS

- A BF: Ballast factor.
- B CCT: Correlated colour temperature.
- C CRI: Colour-rendering index.

- D HID: High-intensity discharge.
- E LER: Luminaire efficacy rating.
- F Lumen: Measured output of lamp and luminaire, or both.
- G Luminaire: Complete lighting fixture, including ballast housing if provided.

V59.1.4 PERFORMANCE REQUIREMENTS

- A Final connections to luminaires shall be in accordance with this specification.
- B Check all ceiling heights to ensure that the specified luminaires shall be mounted at the correct height to the bottom of the fittings.
- C Electromagnetic Compatibility:
 - 1 Ensure all equipment and systems are installed to provide electromagnetic compatibility within the systems and are fully compatible with all other electrical, electronic and radio frequency installations in the same location.

V59.1.5 SUBMITTALS

- A Product Data: For each type of luminaire, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1 Physical description of luminaire including dimensions
 - 2 Ballast, including BF
 - 3 Energy-efficiency data
 - 4 Air and Thermal Performance Data: For air-handling luminaires. Furnish data required in "Submittals" Article in U88 Air Terminal Devices
 - 5 Sound Performance Data: For air-handling luminaires. Indicate sound power level and sound transmission class in test reports certified according to standards specified in U88 Air Terminal Devices
 - 6 Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps
 - 7 Photometric data and adjustment factors based on laboratory tests, complying with BS EN 13032 and BS 4533 for each luminaire type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the luminaire as applied in this Project:
 - a Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer
 - b Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation.
- B Shop Drawings: For nonstandard or custom luminaires. Include plans, elevations, sections, details, and attachments to other work:
 - 1 Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection
 - 2 Wiring Diagrams: For power, signal, and control wiring.
- C Samples: For each luminaire indicated in the Interior & External Luminaire Schedules. Each Sample shall include the following:
 - 1 Lamps and ballasts, installed
 - 2 Cords and plugs
 - 3 Pendant support system.
- D Installation instructions.

- E Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
- 1 Luminaires
 - 2 Suspended ceiling components
 - 3 Partitions and millwork that penetrate the ceiling or extends to within 305 mm of the plane of the luminaires
 - 4 Ceiling-mounted projectors
 - 5 Structural members to which suspension systems for luminaires will be attached
 - 6 Other items in finished ceiling including the following:
 - a Air outlets and inlets
 - b Speakers
 - c Sprinklers
 - d Smoke and fire detectors
 - e Occupancy sensors
 - f Access panels.
 - 7 Perimeter mouldings.
- F Qualification Data: For qualified agencies providing photometric data for luminaires.
- G Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.
- H Field quality-control reports.
- I Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals:
- 1 Provide a list of all lamp types used on Project; use classifications ANSI and manufacturers' codes.
- J Warranty: Sample of special warranty.

V59.1.6 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 will be exposed.
- B Ensure that the whole installation complies with the relevant standards, including the following:
- 1 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)
 - 2 BS 559 - Specification for the design and construction of signs for publicity, decorative and general purposes
 - 3 BS 1362 - Specification for general purpose fuse links for domestic and similar purposes (primarily for use in plugs)
 - 4 BS 1853-2 - Tubular fluorescent lamps for general lighting service. Specification for lamps used in the United Kingdom not included in BS EN 60081, BS EN 60901, BS EN 61195 and BS EN 61199
 - 5 BS ISO 3864-1 Graphical symbols. Safety colours and safety signs. Design principles for safety signs and safety markings
 - 6 BS 7671+A2 - Requirements for electrical installations. IEE Wiring Regulations. Seventeenth edition
 - 7 BS 7693 - Guide to uses of infra-red transmission and the prevention or control of interference between systems
 - 8 BS 7895 - Specification for bayonet lamp holders with enhanced safety
 - 9 BS EN 40 - Lighting Columns
 - 10 BS EN 13032-1+A1 - Lamps and lighting. Measurement and presentation of photometric data of lamps and luminaires. Measurement and file format.
 - 11 BS EN 50107-1 - Signs and luminous-discharge-tube installations operating from a no-load rated output voltage exceeding 1 kV but not exceeding 10 kV

- 12 BS EN 55015 - Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
- 13 BS EN 60061-1+A48 - Specification for lamp caps and holders together with gauges for the control of inter-changeability and safety. Lamps caps
- 14 BS EN 60061-2+A45 - Specification for lamp caps and holders together with gauges for the control of inter-changeability and safety. Lamp holders
- 15 BS EN 60064+A5 - Tungsten filament lamps for domestic and similar general lighting purposes. Performance requirements
- 16 BS EN 60079 - Electrical apparatus for explosive gas atmospheres
- 17 BS EN 60079-14 - Electrical apparatus for explosive gas atmospheres. Electrical installations in hazardous areas (other than mines)
- 18 BS EN 60081+A4 - Double-capped fluorescent lamps. Performance specifications
- 19 BS EN 60188 - High-pressure mercury vapour lamps. Performance specifications
- 20 BS EN 60192 - Low pressure sodium vapour lamps. Performance specification
- 21 BS EN 60357+A3 - Tungsten-halogen lamps (non-vehicle). Performance specifications
- 22 BS EN 60432-1+A2 - Safety specification for incandescent lamps. Tungsten filament lamps for domestic and similar general lighting purposes
- 23 BS EN 60432-2+A2 - Safety specification for incandescent lamps. Tungsten halogen lamps for domestic and similar general lighting purposes
- 24 BS EN 60529 - Specification for degrees of protection provided by enclosures (IP code)
- 25 BS EN 60570 - Electrical supply track systems for luminaires
- 26 BS EN 60598 - Luminaires
- 27 BS EN 60598-1 - Luminaires. General requirements and tests
- 28 BS EN 60598-2-22+A2 - Luminaires. Particular requirements. Luminaires for emergency lighting
- 29 BS EN 60630+A6 - Maximum lamp outlines for incandescent lamps
- 30 BS EN 60730-2-3 - Specification for automatic electrical controls for household and similar use. Particular requirements. Thermal protectors for ballasts for tubular fluorescent lamps
- 31 BS EN 60901+A5 - Specification for single-capped fluorescent lamps. Performance specifications
- 32 BS EN 60921 - Specification for ballasts for tubular fluorescent lamps. Performance requirements
- 33 BS EN 60923 - Auxiliaries for lamps. Ballasts for discharge lamps (excluding tubular fluorescent lamps). Performance requirements
- 34 BS EN 60925 - Specification for performance requirements for D.C. supplied electronic ballasts for tubular fluorescent lamps
- 35 BS EN 60927 - Specification for auxiliaries for lamps. Starting devices (other than glow starters). Performance requirements
- 36 BS EN 60929 - Specification for A.C. supplied electronic ballasts for tubular fluorescent lamps. Performance requirements
- 37 BS EN 60968 - Specification for self-ballasted lamps for general lighting services. Safety requirements
- 38 BS EN 60969 - Self-ballasted lamps for general lighting services. Performance requirements
- 39 BS EN 61047 - Specification for D.C. or A.C. supplied electronic step-down convertors for filament lamps. Performance requirements
- 40 BS EN 61048 - Specification for capacitors for use in tubular fluorescent and other discharge lamp circuits. General and safety requirements
- 41 BS EN 61049 - Specification for capacitors for use in tubular fluorescent and other discharge lamp circuits. Performance requirements
- 42 BS EN 61050 - Specification for transformers for tubular discharge lamps having a no-load output voltage exceeding 1000 V (generally called neon-transformers). General and safety requirements
- 43 BS EN 61195+A1 - Double-capped fluorescent lamps. Safety specifications
- 44 BS EN 61347-2-1+A1 - Lamp control gear. Particular requirements for starting devices (other than glow starters)
- 45 BS EN 61347-2-2 - Lamp control gear. Particular requirements for D.C. or A.C. supplied electronic step-down convertors for filament lamps
- 46 BS EN 61347-2-3 - Lamp control gear. Particular requirements for A.C. supplied electronic ballasts for fluorescent lamps

- 47 BS EN 61347-2-4 - Lamp control gear. Particular requirements for D.C. supplied electronic ballasts for general lighting
- 48 BS EN 61347-2-5 - Lamp control gear. Particular requirements for D.C. supplied electronic ballasts for public transport lighting
- 49 BS EN 61347-2-6 - Lamp control gear. Particular requirements for D.C. supplied electronic ballasts for aircraft lighting
- 50 BS EN 61347-2-7 - Lamp control gear. Particular requirements for D.C. supplied electronic ballasts for emergency lighting
- 51 BS EN 61347-2-8+A1 - Lamp control gear. Particular requirements for ballasts for fluorescent lamps
- 52 BS EN 61347-2-9 - Lamp control gear. Particular requirements for ballasts for discharge lamps (excluding fluorescent lamps)
- 53 BS EN 61347-2-13, Lamp control-gear – Part 2-13: Particular requirements for D.C. or A.C. supplied electronic control-gear for LED modules
- 54 BS EN 61547 - Specification for equipment for general lighting purposes. EMC immunity requirements
- 55 BS EN 61549+A3 - Miscellaneous lamps
- 56 BS EN 62031, LED modules for general lighting – Safety specifications
- 57 BS EN 62035+A2 - Discharge lamps (excluding fluorescent lamps). Safety specifications
- 58 BS EN 62162. Self-ballasted LED lamps for general lighting services with supply voltages. Performance requirements
- 59 BS EN 62262 - Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
- 60 BS EN 62384 DC or AC supplied electronic control gear for LED modules – Performance requirements
- 61 BS EN 62386 Digital Addressable Lighting Interface - Particular requirements for control gear.
- 62 ICEL1001 - Luminaire Registration Scheme
- 63 CIBSE Code for Interior Lighting
- 64 CIBSE Lighting Guides.

- C Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are nationally accredited.
- D Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated.
- E Electrical Components, Devices, and Accessories: Listed and labelled as defined in IEE regulations by a qualified testing agency and marked for intended location and application.
- F Luminaires for hazardous locations shall be listed and labelled for indicated class and division of hazard in accordance with BS EN 60079.
- G Mock-ups: Provide lighting luminaires for mock-ups, complete with power and control connections:
 - 1 Obtain Architect's approval of fixtures for mock-ups before starting installations
 - 2 Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed Work
 - 3 Approved fixtures in mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

V59.1.7 CO-ORDINATION

- A Coordinate layout and installation of luminaires with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

V59.1.8 EXTRA MATERIALS

- A Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents:

- 1 Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type
- 2 Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type
- 3 Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type
- 4 Globes and Guards: Furnish at least one of each type.

V59.2 PART 2 – PRODUCTS

V59.2.1 MANUFACTURERS

- A Products: Subject to compliance with requirements: provide products indicated in equipment schedules and drawings that form part of this specification.

V59.2.2 GENERAL REQUIREMENTS FOR LUMINAIRES AND COMPONENTS

- A Recessed Luminaires: Ensure that luminaires are compatible with the ceiling systems specified in the architectural specifications.
- B Incandescent Lamps: Should not normally be used.
- C Metal Parts: Free of burrs and sharp corners and edges.
- D Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- E Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position.
- F Diffusers and Globes:
- 1 Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation:
 - a Lens Thickness: At least 3 mm minimum unless otherwise indicated
 - b UV stabilized.
 - 2 Glass: Annealed crystal glass unless otherwise indicated.
- G Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- H Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and colour of pole or support materials.
- I Factory-Applied Labels: Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place:
- 1 Label shall include the following lamp and ballast characteristics:
 - a "USE ONLY" and include specific lamp type
 - b Lamp diameter code, tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires
 - c Lamp type, wattage, bulb type and coating (clear or coated) for HID luminaires
 - d Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires
 - e Ballast type for HID luminaires
 - f CCT and CRI for all luminaires.
- J Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic interference as required by BS EN 61547. Fabricate luminaires with one filter on each ballast indicated to require a filter.
- K Air-Handling Fluorescent Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly specified in U88 Air Terminal Devices:
- 1 Air-Supply Units: Slots in one or both side trims join with air-diffuser-boot assemblies
 - 2 Heat-Removal Units: Air path leads through lamp cavity
 - 3 Combination Heat-Removal and Air-Supply Unit: Heat is removed through lamp cavity at both ends of the fixture door with air supply same as for air-supply units

- 4 Dampers: Operable from outside fixture for control of return-air volume
- 5 Static Fixture: Air-supply slots are blanked off, and fixture appearance matches active units.

V59.2.3 LUMINAIRES

General Purpose

- A Standards:
- 1 Supply luminaires with photometric data in accordance with BS EN 13032-1+A1
 - 2 Supply luminaires in accordance with BS EN 60598.
- B Classification - in accordance with BS EN 60598-1.
- C Provide secondary support for translucent covers, diffusers and gear trays so they are prevented from falling when their primary fixing is released.
- D Ensure luminaires of similar type have same photometric performance as published data within the tolerances defined by BS EN 13032-1+A1.
- E Ensure luminaires comply with BS EN 61547 for electromagnetic compatibility (EMC) immunity.
- F Physical protection - in accordance with BS EN 62262 (IK) or in accordance with BS EN 60529 (IP).
- G Where safety glass specified, fit luminaire with cover glass to protect against ultra-violet emission and risk from explosion of lamps

Special Applications

- H Standards:
- 1 Supply luminaires with photometric data in accordance with BS EN 13032-1+A1
 - 2 Supply luminaires in accordance with BS EN 60598.
- I Classification - in accordance with BS EN 60598-1.
- J Ensure luminaires comply with BS EN 61547 for electromagnetic compatibility (EMC) immunity.
- K Physical protection - in accordance with BS EN 62262 (IK) or in accordance with BS EN 60529 (IP).

V59.2.4 TYPES OF LAMPS

- A Refer to Schedule of Luminaires for application of lamp types.
- B Tungsten Filament:
- 1 Comply with BS EN 60064, BS EN 60432-1 and BS EN 60630. Supply electronic step-down converters for filament lamps in accordance with BS EN 61047 and BS EN 61347-2-2. Comply with BS EN 61549 for double capped and ELV lamps.
- C Fluorescent:
- 1 Internationally specified tubular fluorescent lamps in accordance with BS EN 60081+A4
 - 2 UK tubular fluorescent lamps in accordance with BS 1853-2
 - 3 Single capped fluorescent lamps in accordance with BS EN 60901+A5 and BS EN 61199.
 - 4 Double capped fluorescent lamps in accordance with BS EN 60081+A4 and BS EN 61195+A1
 - 5 Self-ballasted lamps in accordance with BS EN 60969 and BS EN 60968.
- D Tungsten Halogen:
- 1 Comply with BS EN 60432-2+A2 or BS EN 60357+A3.
- E High Pressure Mercury Vapour:
- 1 Comply with BS EN 60188 and BS EN 62035+A2.

- F Metal Halide:
- 1 Comply with BS EN 62035+A2 where appropriate.
- G High Pressure Sodium Vapour:
- 1 Comply with BS EN 60662 and BS EN 62035+A2.
- H Low Pressure Sodium Vapour:
- 1 Comply with BS EN 60192 and BS EN 62035+A2.
- I LED:
- 1 Comply with IEC/PAS 62717 and IEC/PAS 62722.
- J Manufacturer:
- 1 Ensure that lamps of each type are from same manufacturer.

V59.2.5 LAMP BALLASTS AND STARTERS

- A Refer to Luminaire Schedule for application.
- B Fluorescent:
- 1 Ballasts:
 - a BS EN 61347-2-8+A1 and BS EN 60921
 - b BS EN 61347-2-4, 2-5, 2-6 and 2-7 and BS EN 60925 for D.C. supplied electronic ballasts
 - c BS EN 61347-2-3 and BS EN 60929 for fluorescent lamps in accordance with BS EN 60081 and BS EN 60901
 - d Supply thermal protectors for ballasts for tubular fluorescent lamps in accordance with BS EN 60730-2-3.
 - 2 Starters - BS EN 61347-2-1+A1: 2006 and BS EN 60927:
 - a Use low distortion type.
 - 3 Discharge:
 - a Ballasts - BS EN 61347-2-9 and BS EN 60923
 - b Starters - BS EN 61347-2-1+A1 and BS EN 60927.

V59.2.6 LED LAMP CONTROL GEAR

- 1 Type 1 - Ballasted:
 - a BS EN 61347-2-13
 - b BS EN 62384.
- 2 Type 2 – Semi-Ballasted:
 - a BS EN 61347-2-13
 - b BS EN 62384.
- 3 Type 3 – Non-Ballasted:
 - a BS EN 61347-2-13
 - b BS EN 62384.

V59.2.7 LED LAMP LIFE AND LIGHT LOSS

- A Light Loss shall be L90 after 50,000hours unless stated otherwise in the Luminaire Schedules.
- B Physical Failure – LED life shall be F10 after 50,000 hours unless stated otherwise in the Luminaire Schedules.
- C Lumen depreciation shall achieve a lumen maintenance code of 9 unless stated otherwise in the Luminaire Schedules.

- D The rated chromaticity co-ordinate values for both initial and maintained shall have a Macadam ellipse of 3 step or better.

V59.2.8 ORIENTATION

- A Install luminaires in positions indicated, and in horizontal plane unless otherwise indicated.

V59.2.9 CLEANLINESS

- A Ensure luminaires are clean and grease free on handover.

V59.2.10 CONTROL GEAR AND COMPONENTS

- A Ensure control gear and components are suitable for lamp type, wattage and starting characteristics. Obtain from manufacturers written confirmation of compatibility.

V59.2.11 CIRCUIT LOSSES

- A Use high frequency ballasts to ensure the installed circuit load does not exceed 3 W/m²/ 100 lux.

V59.2.12 CAPACITORS

- A Use capacitors in accordance with BS EN 61048 and BS EN 61049 in tubular fluorescent, high pressure mercury and low pressure sodium vapour discharge lamp circuits.

V59.2.13 SUPPLY TERMINALS

- A Use screw terminals for supply cables and circuit protective conductors, sized to terminate up to three 2.5mm² conductors. Provide separate terminal blocks for each incoming circuit, with marking to identify each circuit.

V59.2.14 FUSE

- A Include a fuse holder and BS 1362 fuse in each incoming circuit phase connection.

V59.2.15 INTERFERENCE

- A Comply with BS EN 55015.

V59.2.16 REMOTE GEAR

- A Locate control gear in separate lockable cabinet of sheet steel with same degree of protection and finish specified for luminaire.

V59.3 PART 3 – EXECUTION

V59.3.1 INSTALLATION

- A Luminaires:
- 1 Set level, plumb, and square with ceilings and walls unless otherwise indicated
 - 2 Install lamps in each luminaire.
- B Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.
- D Material of Supporting Surface: Ensure classification of luminaires is appropriate. Do not mount luminaires on readily flammable surfaces.
- E Installation in Potentially Explosive Atmospheres: Comply with BS EN 60079-14.
- F Install luminaires in areas with infra-red control systems or data bearers so as to cause minimum disturbance to the infra-red transmission system in accordance with BS 7693.
- G Signs and High-Voltage Installation: Comply with BS 559 and BS EN 50107-1
- H Extra Low Voltage Tungsten Halogen Lamps: Use same wattage lamp on luminaires fed from common transformer. Supply each luminaire on common transformer by separate cable of same cross-sectional area.
- I Air-Handling Luminaires: Install with dampers open and ready for adjustment.

V59.3.2 IDENTIFICATION

- A Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in V80 Electrical Identification.

V59.3.3 FIELD QUALITY CONTROL

- A Handle, store and install luminaires, lamps and components of the lighting control system in accordance with the manufacturer's recommendations.
- B Obtain all equipment and components from a single source, unless otherwise specified.
- C Inspect all equipment and components on delivery, before fixing and after installation, and reject and replace any that are defective.
- D Record all commissioning, measurements and tests.

V59.3.4 STARTUP SERVICE

- A Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

V59.3.5 ADJUSTING

A Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark:

- 1 Adjust aimable luminaires in the presence of Architect.

V80 ELECTRICAL IDENTIFICATION

Contents

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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 the schedules of equipment.
- C Refer also to all other sections including the following:
- 1 V11 "Low Voltage Connection"
 - 2 V30 "Low Voltage Distribution Systems"
 - 3 V31 "Low Voltage Switchgear"
 - 4 V50 "General Lighting Systems"
 - 5 V51 "Automatic Lighting Controls"
 - 6 V59 "General Luminaires and Lamps"
 - 7 V60 "External Lighting Systems"
 - 8 V81 "Earthing and Bonding Systems"
 - 9 V85 "Electrical Testing and Inspection".
 - 10 Y41 Building Monitoring and Management
 - 11 Y50 Electrical Commissioning
 - 12 Y60 Conduit and Trunking
 - 13 Y61 LV and ELV Cables
 - 14 Y63 Cable Supports
 - 15 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/LS0H: 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 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 substation doors
 - c Warning notices and labels for all HV and LV distribution rooms
 - 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

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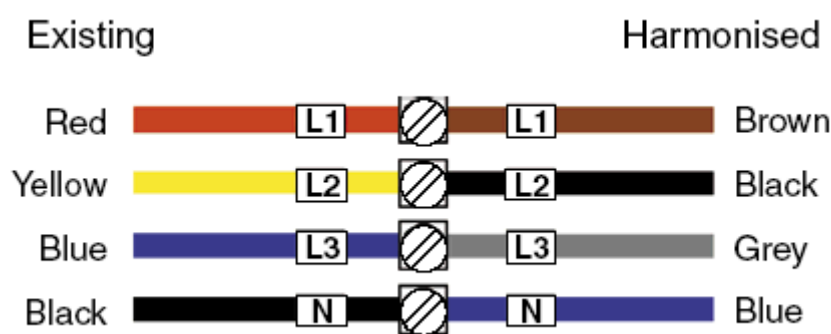
D For distributed electrical services the following acronyms are used

ELECTRICAL DISTRIBUTION	
HV	High Voltage in excess of 1kV and $\leq$ 35kV
MV	Medium Voltage in excess of 1kV and $\leq$ 35kV
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:
- circuit 6 brown phase is marked: **6L1**
 - circuit 8 black phase is marked: **8L2**
 - circuit 10 grey phase is marked: **10L3**
 - 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:
- circuit 6 on Lighting Distribution Board No.10 on level 3: **DBL-03-10/ 6L1**
 - circuit 8 on Power Distribution board No. 6 on level 2: **DBP-02-06/ 8L2**
 - circuit 10 on Lighting Control Panel No 2 on ground floor: **LCP-00-02/10L3**
 - 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:
- circuit 8 on Power Distribution Board No.6 on level 2: **DBP-02-06/ 8L1L2L3**
 - 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 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 V11 "Low Voltage Connection"
 - 2 V30 "Low Voltage Distribution Systems"
 - 3 V31 "Low Voltage Switchgear"
 - 4 V50 "General Lighting Systems"
 - 5 V51 "Automatic Lighting Controls"
 - 6 V59 "General Luminaires and Lamps"
 - 7 V60 "External Lighting Systems"
 - 8 V69 "Specialist Luminaires and Lamps"
 - 9 V80 "Electrical Identification"
 - 10 V85 "Electrical Testing and Inspection".
 - 11 Y41 Building Monitoring and Management
 - 12 Y50 Electrical Commissioning
 - 13 Y60 Conduit and Trunking
 - 14 Y61 LV and ELV Cables
 - 15 Y63 Cable Supports
 - 16 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 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.
- N The contractor shall supply and install Main equipotential bonds and supplementary bonds in accordance with BS 7671.
- O 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.

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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 All Mechanical equipment within plant rooms
 - 15 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 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.

V81.2.22 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.

V81.2.23 METALLIC FENCING

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

V81.2.24 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.

V81.2.25 EQUIPMENT EARTHING

- A Install separate insulated equipment earthing conductors with all feeders, branch circuits and final circuits.
- B Air-Duct Equipment Circuits: Install insulated equipment earthing conductor to duct-mounted electrical devices operating at 230 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C 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.
- D 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.
- E 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 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.

V81.3.3 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.

V81.3.4 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.

V81.3.5 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."

V81.3.6 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.

V81.3.7 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.

W50 FIRE DETECTION AND ALARM SYSTEMS

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W50.1 PART 1- GENERAL

W50.1.1 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 schedules of equipment.
- C For system operating descriptions, operating conditions and interfaces 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 Systems
 - 3 W40: Access Control Systems
 - 4 W51: Voice Evacuation systems.
 - 5 Y41: Building Management Systems and Control
 - 6 Y50: Testing and Commissioning of Mechanical and Electrical services
 - 7 Y60: Conduit and Trunking
 - 8 Y61: LV and ELV Cables
 - 9 Y63: Cable Supports
 - 10 Y90: Fixing to Building

W50.1.2 SUMMARY

- A This specification covers the provisions for the design, supply, installation and commissioning of the voice Fire Detection and Alarm System (FDAS). It includes for the delegated design of the systems by a specialist Fire Alarm contractor who is required to integrate the systems with other systems forming part of the life safety strategy for the building including:
 - 1 PAVA: Public Address and voice Alarm systems (where provided): W51
 - 2 Smoke Extract fans
 - 3 Access control systems: W40
- B The extent of the Fire Detection and Alarm System (FDAS) is defined in Section B of this specification, associated schedules and drawings. The system is required to be of the addressable type approved to BS EN 54 parts 2, 4 and 13.
- C The system components are to be freely available from a number of sources, (i.e. open protocol system), and capable of supporting at least four independent protocols providing:
 - 1 1-4 loop formats
 - 2 True peer to peer networking
 - 3 Intelligent remote terminals
 - 4 BMS interface
 - 5 Programmable I/O devices
 - 6 Circuit monitoring
- D The scope of works includes the provision of a Fire Alarm Cause and Effect strategy and integrated testing and commissioning with witnessing by the Commissioning Management Specialist. For detail refer to section Y50 of this specification.
- E Provide all materials, equipment, accessories, services and tests necessary to complete the FDAS as indicated on the drawings and within the specifications and make ready for operation.
 - 1 Include for
 - a all equipment necessary for the installation,

- b All software & hardware
- c All detectors, interface devices, alarms, display and monitoring panels and accessories
- d Cabling,
- e Fixings,
- f Containment,
- g Completion Certificates
- h Information for Operation and Maintenance.
- i Design, Installation and Record Drawings
- j Testing,
- k Commissioning,
- l Demonstration of the FDAS and associated systems
- m Employer's training
- n 12 months post contract maintenance

- F Note that some containment provisions may be provided within the electrical sub-contractor's scope of works. Review and comment on the intended provisions of containment by others and provide additional containment where necessary to suit the intended routings and cable carrying capacity for the final design.
- G Co-ordinate with the electrical sub-contractor and define the location and capacity of the FDAS system power requirements. Power supplies normally comprise a 230Vac 50Hz single phase un-switched fused spur adjacent to the FDAS component position.

W50.1.3 DEFINITIONS

- A The following acronyms are used in this specification
- 1 EVC: Emergency Voice Communication
 - 2 GUI: Graphical User Interface (touchscreen PC)
 - 3 PA: Public Address. Electro-acoustic system used to address a group of people.
 - 4 PAVA: A combined voice alarm and public address system
 - 5 VA: Voice Alarm. An electro-acoustic system used to broadcast speech messages or warning signals in an emergency. Often used for phased evacuations during a fire alarm.
 - 6 VAICE: Voice alarm control and indicating equipment. A component of a voice alarm system that generates and transmits voice alarm signals to loudspeaker circuit(s) when it receives alarm signal(s) from a fire detection and alarm system and/or manual controls
 - 7 Zone: Separate group of loudspeakers and associated supply wiring that may be arranged for selective switching between different channels.
 - 8 FDAS: Fire Detection and Alarm System
 - 9 FAP: Fire Alarm Control Panel
 - 10 FAR: Fire Alarm Repeater Panel
 - 11 FVP: Fireman's Ventilation Control Panel
 - 12 MCP – Motor Control Panel
 - 13 VESDA: Very Early Smoke detection systems
 - 14 BAFE: British Approvals for Fire Equipment
 - 15 LPCB: Loss Prevention Certification Board
- B The following definitions apply;
- 1 Addressable system: Systems in which the signals from detectors, manual call points or any other devices are individually identified at the control and indicating equipment.
 - 2 Category L: FDAS intended for the protection of Life see BS 5839-1
 - 3 Category P: FDAS intended for the protection of property see BS 5839-1
 - 4 Refuge Area: Temporary waiting area of relative safety. Should be protected from a fire for a period of time sufficient to enable the evacuation sequence to be completed. Commonly located within fire protected stairwells. Can be a protected lobby, protected corridor or protected room. Can also be a flat

roof, balcony or similar space sufficiently protected or remote, with its own means of escape. Should be accessible for a person in a wheelchair

W50.1.4 DELEGATED DESIGN

- A Employ the services of a specialist FDAS contractor to develop the design, supply, install, clean, test and commission the complete FDAS to meet the requirements of BS 5839-1, BS 9999, BAFE SP203 and LPS014 standards, this specification and the drawings. Use one of the following specialist companies:
- 1 Honeywell Morley
 - 2 Advanced Electronics
 - 3 ADT
 - 4 Tyco
- B Ensure that the company is a member of the Fire and Security Association (FSA) and that the operatives are fully trained and certified in the installation of fire detection and alarm systems. Ensure also that the specialist company is registered under the BSI quality assurance scheme.
- C Before commencement of the design, ensure that the FDAS protection category is agreed with the Employer, Employer's Building Insurers and Authorities having Jurisdiction including Building Control and the Fire Officer. Ensure that both "Life Protection" and "Property Protection" risks are assessed. The provision of fire safety systems for life safety does not necessarily give adequate protection to property or to business continuity. Refer also to the project specific "Fire Strategy Report" where these requirements may be set out.
- D The FDAS is to be designed as an analogue addressable, electrically supervised, zone annunciated, nominally 24Vdc fire detection and alarm system. Refer also to section B of this specification.
- E The intent of this specification is to provide a peer-to-peer networked, stand-alone, FDAS system utilizing open protocols in one open, interoperable system.
- F The system including the detectors, controls, and alarms interfaces with other building services and in particular the following systems.
- 1 PAVA: Public Address and voice Alarm systems (where provided): see W51
 - 2 Access control systems: W40
- G This specification and associated drawings and documents do not list every item of equipment or material needed but are indicative of the design intent. The FDAS specialist is responsible for providing the complete detailed design and ensuring that the equipment has the required connectivity, functionality and performance. The system includes but is not limited to the following items:
- 1 Panels:
 - a FAP: Main Fire Alarm Control Panel(s)
 - 2 Telephone line modem
 - 3 Power Supplies (including 72-hour standby power supply in each fire alarm control panel)
 - 4 Addressable intelligent devices as necessary and as indicated on the drawings:
 - a Manual call point units
 - Break glass
 - Key operated Break glass
 - b Heat detectors with and without sounders, beacons, visual alarm devices
 - Heat Detectors
 - Heat Detectors rate of rise
 - Heat Detectors infra-red
 - Area heat detectors
 - c Smoke detectors with and without sounders, beacons, visual alarm devices
 - Ionisation type
 - Optical type

- Duct mounted
- Floor/ceiling void
- Combined smoke and heat
- Detector Beam transmitter & reflector
- Aspirator sampling (VESDA)
- d Gas detectors with and without sounders, beacons, visual alarm devices
 - Carbon monoxide
- e Combined smoke and heat detectors
- f Flame detectors
- 5 Interfaces:
 - a Interface modules
 - b Door hold open devices
 - Electro-magnetic
 - Pneumatic
 - c HVAC system fans
 - d HVAC system dampers
 - e BMS systems: for control of plant
 - f MCPs for control of plant
 - g Kitchen ventilation and gas controls
 - h PA and VA systems
- 6 System components:
 - a Fire alarm Bells
 - b Fire alarm Buzzers
 - c Fire alarm Sirens
 - d Visual Indicators: Xenon flashing beacons/strobe
 - e Sounders: wall/ceiling mounted
 - f Fire alarm telephone call
 - g Remote LED indicators for fire alarm devices
 - h Fire/VA emergency microphone
 - i Fire alarm system fault monitoring
 - j Battery pack up
 - k Fire telephone points
 - l Fireman's microphone
 - m Cabling
- 7 Graphical user interface and peripheral equipment if indicated in section B and/or the drawings
- H All rights to maintenance and future upgrades of hardware and software to be transferred to the Employer.
- I Provide warranties as per contract preliminaries and section A of this specification and main contract preliminaries.

W50.1.5 FIRE ALARM SYSTEMS CAUSE AND EFFECT STRATEGY

- A Fire Alarm systems are to be commissioned by their specialist sub-contractor who is responsible for preparing the detailed Cause and Effect Strategy in a matrix format showing the interrelationship between the Fire Alarm activation inputs and the effect of the activation on various installations. Fire Alarm sub-contractor is to develop the cause and effect matrix with assistance from:
 - 1 Commissioning management Specialist
 - 2 BMS Sub-contractor
 - 3 Security/access control sub-contractor
 - 4 Emergency Lighting sub-contractor
 - 5 Lighting control systems sub-contractor
 - 6 Trade contractors for each MEP system
 - 7 Voice Alarm sub-contractor if not FDAS provider

- 8 Public Address sub-contractor
- 9 Building Control

B The following is a basic guide which may need to be reduced or extended depending on the complexity of the project and the fire strategy for the project:

- 1 Typical System Inputs (Causes):
 - a Break Glass activated (zone by zone)
 - b First Knock (smoke/heat detector) first alarm activated (zone by Zone)
 - c Second Knock (smoke/heat detector) second alarm activated (Zone by Zone)
 - d Fire Alarm system manually reset
 - e Smoke detected in areas served by smoke extract fans or automatic louvres
 - f Smoke detected in escape routes
 - g Fire alarm in test mode
 - h Fire alarm panel fault
 - i Fire Alarm Pre-Alarm faults
 - j Fireman's override switch operated
 - k Gas Leak detection system operated
 - l Refrigerant leak detection system operated
 - m Disabled Alarm activated
- 2 Possible System Outputs (Effects):
 - a Full evacuation in Zone
 - b Activation of warning beacons
 - c Common fire alarm signal on panel
 - d Activation of LED indication on local device under alarm/test
 - e Event logged on main and repeater fire panels
 - f Status signal to be sent
 - g Remote dial out
 - h Activation of "Full System Alarm"
 - i Release of fail-safe security doors
 - j Door hold open release
 - k Signal to each MCP
 - l AHU plant shutdown
 - m Gas valves shut
 - n Emergency lighting operated

C Submit the detailed Cause and Effect matrix for approval and incorporate any requirements into the final submittal.

W50.1.6 PERFORMANCE REQUIREMENTS

A Design the system for property and/or life protection as indicated in section B where the following scope applies: Note if nothing is indicated in section B allow for an L1 system.

- 1 Life Protection: To enhance the period of time for escape.
 - a L1: FDAS is installed throughout all areas of the building
 - b L2: FDAS is installed only in defined parts of the building and early warning in specified areas of high fire hazard and/or high fire risk. As for L3 rooms that open into escape routes are to be provided with protection.
 - c L3: Designed to give early warning for all occupants (other than those in the room of origin) to escape safely. Provide detectors in all rooms that open into escape routes.
 - d L4: Systems installed within escape routes (circulation areas, corridors and stairways) and any other areas considered necessary
 - e L5: Special areas requiring design for a specific objective other than L1, L2, L3 or L4.
- 2 Property Protection:

- a P1: Systems installed throughout all areas of the building to provide earliest possible warning and so minimise the time between ignition and arrival of fire fighters.
 - b P2: Systems only installed in defined parts of the building. Designed to give early warning in areas of fire hazard or where fire risk to property or business continuity is high
- 3 For hospital projects comply with HTM05-03 Part B: Fire Detection and Alarm systems
- B Standards: Manufacturer must have relevant factory production control procedures in place – i.e. BS EN ISO9001-and comply with the following
 - 1 BS EN 54-1: Fire detection and fire alarm systems. Introduction
 - 2 BS EN 54-2+A1: Fire detection and fire alarm systems. Control and indicating equipment
 - 3 BSEN54-4: for power supplies.
 - 4 BS EN54-13: Compatibility Assessment of System Components
 - 5 Induction loops: BS EN 60118-4
- C Applications: Use smoke or heat detectors of the most suitable type for the application according to the drawings and where not indicated use the following guidelines:
 - 1 Use heat detectors where smoke detectors are unsuitable. Smoke detectors are used whenever possible since smoke detection provides earlier warning of fire than heat detection.
Heat detectors should be used if there is a danger of nuisance alarms from smoke detectors.

Detector Type	Application	Not suitable for
Ionisation smoke detector	General purpose smoke detector. Best for fast flaming fires	Areas subject to smoke, steam, dust or dirt during normal use
Optical smoke detector	General purpose smoke detector. Best for smouldering fires	Areas subject to smoke, steam, dust or dirt during normal use
Photo-thermal multi-criteria detector	General Purpose detector. For smouldering and fast flaming fires	Areas subject to smoke, steam, dust or dirt during normal use
Optical Beam Detector	Large and high rooms	Areas subject to smoke, steam, dust or dirt during normal use
Rate of Rise heat detector	Areas subject to smoke, steam, dust or dirt during normal use	Areas subject to rapid changes of temperature or temperatures over 43°C
Fixed temperature heat detector	Areas subject to smoke, steam, dust or dirt and rapid changes of temperature during normal use	Areas subject to temperatures over 43°C
High temperature fixed heat detector	Areas subject to smoke, steam, dust or dirt and temperatures over 43°C during normal use	Areas subject to temperatures over 70°C
- D Comply also with the limitations on the maximum ceiling types for certain types of detectors;

Detector Type	Maximum Ceiling Height
Point Smoke detector to BS EN 54-7	10.5m
Heat Detector BS EN 54-5 Class A1 (58°C Threshold)	9m
High temperature heat detector BS EN 54-5 Class B (Threshold 78°C)	6m
Optical Beam Detectors	25m

E Aspirating Detectors: Aspirating detectors may be used for spaces which are environmentally demanding such as:

- 1 Clean rooms
- 2 Areas where goods are easily damaged by fire
 - a Electronics
 - b Flammable liquid stores
 - c Telecoms/Data rooms
- 3 Areas where conventional ceiling detectors cannot be reached
- 4 Areas where conventional detectors would not react quickly enough
- 5 Areas where conventional detectors could be tampered with
- 6 Shafts and service ducts
- 7 Wet or dusty environments
- 8 Ceiling and floor voids

F All power supply cables to the systems and those used in the distribution circuits to be fire resisting cables of the following types (Refer also to specific project requirements indicated in section B and the specific cable types indicated in specification Y61):

- 1 Cabling: To be enhanced or standard type conforming to the following:
 - a BS EN 60702-1: mineral-insulated copper-sheathed cable with an overall polymeric covering and with terminations conforming to BS EN 60702-2;
 - b BS 7629-1: Electric cables. Specification for 300/500 V fire resistant, screened, fixed installation cables having low emission of smoke and corrosive gases when affected by fire. Multicore cables
 - c BS 7846: Electric cables. Thermosetting insulated, armoured, fire-resistant cables of rated voltage 600/1 000 V for fixed installations, having low emission of smoke and corrosive gases when affected by fire.
- 2 Use enhanced fire-resistant cabling for the following locations or where required by Building Control/ Fire officer and standard cabling for all other locations.
 - a Un-sprinklered buildings in which evacuation is in more than three phases
 - b Un-sprinklered buildings greater than 30m high
 - c Un-sprinklered premises and sites in which a fire in one area could affect cables of critical signal paths associated with areas remote from the fire, where people could remain in occupation during the course of the fire. Examples may be large hospitals with central VACIE and progressive horizontal evacuation, and certain large industrial sites;
 - d Any other buildings in which the designer or regulatory authority, following a fire risk assessment, considers that the use of enhanced fire resisting cables is necessary.
- 3 Standard Fire resisting cabling: Comply with the following:
 - a Fire resistance: 30mins BS EN 50200
 - b Classification: PH30
- 4 Enhanced fire resisting cabling: Comply with the following:
 - a Fire resistance: 120mins BS EN 50200
 - b Classification: PH120
 - c Survival duration: 120 minutes tested to BS 8434-2
- 5 Colour: All fire alarm cabling to be coloured RED

G Provide software maintenance for one year after handover. Refer to section B for project specific details

- H Provide a guarantee that the installed systems will either continue to be produced and/or be maintainable for a period of at least 10 years. Elemental equipment substitution is accepted for peripheral items subject to specific approval, but not for the microprocessor-based equipment.
- I Where components are provided from different manufacturers provide certification that the complete systems are LPCB approved and BAFE certified.

W50.1.7 SUBMITTALS

- A The following documents, drawings and samples are to be submitted for approval in line with the main contractor's programme and commissioning management specialist's detailed programme.
- 1 **Data Sheets:** Provide detailed original specification/data sheets for the proposed system equipment.
 - 2 **Product Lists:** List all types of equipment and components provided as part of the system, including model numbers, mounting accessories and quantities.
 - 3 **Description of Operation:** Provide a complete and detailed description of operation of the system, including all interfaces with other systems forming part of the fire and life safety strategy.
 - 4 **Samples:** Provide samples of all the field devices
 - 5 **Standby battery calculations** showing:
 - a system power requirements
 - b formulae used to calculate power requirements
 - 6 **Detailed Design Drawings** showing the following and the co-ordination with the architecture:
 - a Schematic diagram of the complete system
 - b Interconnection schematic to illustrate the interfaces with other services systems
 - c Detector locations and types
 - d Alarm device location
 - e Interface locations and equipment controlled/monitored
 - f Control panel locations
 - g Zonal arrangement (alarm and detection)
 - h Aspiration detection coverage and equipment
 - i Call points
 - j Network schematic indicating interconnectivity and cabling between system components
 - k Locations and facilities required for power connections by others
 - l Any containment (trays, baskets or conduits) required to complete the installation.
 - 7 **Installation drawings** showing
 - a Device addresses
 - b Circuit loop cabling routes and arrangement and cable numbers and types
 - c Short circuit isolator locations
 - d Device identifiers and labels
 - e And the items described under design drawings above with enhanced level of detail.
 - 8 **Record drawings:** Based on the installation drawings but amended to show the final installation
 - 9 **Fire Alarm cause and effect Strategy:** Draft, intermediate and final versions submitted for approval.
 - 10 **Testing and commissioning records:** Record the results of all testing and commissioning on approved record sheets. Testing and commissioning to be witnessed by the Commissioning Management Specialist.
 - 11 **Final Completion Certificates**
 - 12 **Sound level calculations** for all areas demonstrating compliance with the requirements
 - 13 **Building Control /Fire Officer Submittal Requirements:**
 - a Description of Operation
 - b Design drawings
 - c Testing and commissioning records
 - d Final test certificates
 - 14 **Operation and Maintenance Data:** For systems and components to include in the operation and maintenance manuals by the Technical Documentation Specialist employed by the commissioning management specialist. Refer to Y50

- 15 **Handover Information** as requested by the Technical Documentation specialist for incorporation into the following documents:
- a Operators Logbook
 - b Building Manual
 - c Building User Guide
 - d Operation and Maintenance Manuals for the Fire Alarm system incorporating any agreed variations from the original design specification.
 - e Record drawings
 - f Asset Register

W50.1.8 QUALITY ASSURANCE

- A Installer Qualifications: Personnel to be trained and certified by the specialist FDAS manufacturer for installation of units required for this project.
- B Installer Qualifications: Installation to be carried out by personnel certified to operate as an FDAS installer in the region.
- C All system components shall be LPCB approved UL and/or CE listed and clearly marked as such by the manufacturer.
- 1 Approvals:
- a Third party certification: BAFE SP203
 - b LPCB: Standard LPS 1014 certificate of conformity
- D Ensure that the whole installation complies with the relevant standards, including the following:
- 1 BS 5839-1: Fire detection and alarm systems for buildings. Code of practice for system design, installation, commissioning and maintenance
 - 2 BS 5839-6: Fire detection and fire alarm systems for buildings. Code of practice for the design, installation, commissioning and maintenance of fire detection and fire alarm systems in domestic premises
 - 3 BS 6266: Fire protection for electronic equipment installations. Code of Practice
 - 4 BS 7273 (All Parts) Code of practice for the operation of fire protection measures
 - 5 BS 7629-1: Electric cables. Specification for 300/500 V fire resistant, screened, fixed installation cables having low emission of smoke and corrosive gases when affected by fire. Multicore cables
 - 6 BS 7671+A3 - Requirements for electrical installations. IET Wiring Regulations. Seventeenth edition
 - 7 BS 9999: Expert Commentary on BS 9999:2017. Fire safety in the design, management and use of buildings. Code of practice
 - 8 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
 - 9 BS 8300-2: Design of an accessible and inclusive built environment. Buildings. Code of practice
 - 10 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
 - 11 BS 9999: Fire safety in the design, management and use of buildings. Code of practice
 - 12 BS EN 54-1: Fire detection and fire alarm systems. Introduction
 - 13 BS EN 54-2+A1: Fire detection and fire alarm systems. Control and indicating equipment
 - 14 BS EN 54-3: Fire detection and fire alarm systems. Fire alarm devices. Sounders
 - 15 BS EN 54-4: Fire detection and fire alarm systems. Power supply equipment
 - 16 BS EN 54-5: Fire detection and fire alarm systems. Heat detectors. Point detectors
 - 17 BS EN 54-7: Fire detection and fire alarm systems. Smoke detectors. Point detectors using scattered light, transmitted light or ionization
 - 18 BS EN 54-10: Fire detection and fire alarm systems. Flame detectors. Point detectors
 - 19 BS EN 54-11: Fire detection and fire alarm systems. Manual call points

- 20 BS EN 54-12: Fire detection and fire alarm systems. Smoke detectors. Line detectors using an optical light beam
- 21 BS EN 54-13: Fire detection and fire alarm systems. Compatibility and connectability assessment of system components
- 22 BS EN 54-17: Fire detection and fire alarm systems. Short-circuit isolators
- 23 BS EN 54-18: Fire detection and fire alarm systems. Input/output devices
- 24 BS EN 54-20: Fire detection and fire alarm systems. Aspirating smoke detectors
- 25 BS EN 54-21: Fire detection and fire alarm systems. Alarm transmission and fault warning routing equipment
- 26 BS EN 54-24 - Fire detection and fire alarm systems. Components of voice alarm systems. Loudspeakers
- 27 BS EN 54-25: Fire detection and fire alarm systems. Part 25. Components using radio links
- 28 BS EN 1155: Building hardware. Electrically powered hold-open devices for swing doors. Requirements and test methods
- 29 BS EN 1634-2: Fire resistance and smoke control tests for door, shutter and openable window assemblies and elements of building hardware. Fire resistance characterisation test for elements of building hardware
- 30 BS EN 14604 - Smoke alarm devices (12/30248102 DC draft for public comment)
- 31 BS EN 50130-4 + A1: Alarm systems. Electromagnetic compatibility. Product family standard: Immunity requirements for components of fire, intruder and social alarm systems
- 32 BS EN 50200: Method of test for resistance to fire of unprotected small cables for use in emergency circuits
- 33 BS EN 60079-11: Explosive atmospheres. Equipment protection by intrinsic safety "i"
- 34 BS EN 60079-14: Explosive atmospheres. Electrical installations design, selection and erection
- 35 BS EN 60702-1 + A1: Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V. Cables
- 36 BS EN 60079-17: Explosive atmospheres. Electrical installations inspection and maintenance
- 37 BS EN ISO 13943: Fire Safety Vocabulary
- 38 BS ISO 7240-8: Fire detection and alarm systems for buildings. Part 8. Point-type fire detectors using a carbon monoxide sensor in combination with a heat sensor
- 39 BS ISO 7240-15: Fire detection and alarm systems for buildings. Point-type fire detectors using smoke and heat sensors
- 40 Fire Protection Industry Scheme, Reference SP203 Part 1 For the Design, Installation, Commissioning & Maintenance of Fire Detection and Fire Alarm Systems
- 41 Electrical supply regulations
- 42 Insurers requirements
- 43 HTM 05-03 Part B (England and Wales)
- 44 SHTM 82 (Scotland)
- 45 All building control and fire officer requirements.

W50.1.9 COORDINATION

- A The FDAS Contractor is responsible for developing and finalising the design with the CA or appointed representative. The information provided at tender stage is preliminary and adjustments must be made to accommodate the design development and the final selection of plant and equipment.
- B Design development will also require the incorporation of Building Control or Fire Officer's later requirements.
- C Coordinate layout and installation of FDAS accessories with other elements the construction including HVAC equipment, fire-suppression system, door swings and partition/wall constructions.
- D Cooperate with the architect and other contractors to ensure reliable and well-documented interfaces between systems.
- E Where FDAS systems are interfaced to other systems, responsibility for design, supply and installation of equipment shall be as described below: -

- 1 Electrical System:
 - a Inform the electrical contractor of power supplies required for FDAS equipment
 - b The electrical contractor to specify, install and supply the power cable to FAP, FRPs, and FVPs or field equipment requiring a separate electrical supply. The electrical contractor may opt to run the power supply to an isolator adjacent to the equipment.
 - c Terminate power supply cable at fixed fire alarm panels. If the electrical contractor has run the power supply to an adjacent isolator, the FDAS specialist is responsible for electrical connections from the isolator to the equipment rack
 - d Provide a means to double-pole isolate the power supply integral to fixed panels unless a local isolator is installed by the electrical contractor
 - e The FDAS specialist is responsible for all fire alarm cabling distribution.
- 2 PAVA System (where provided)
 - a The PAVA specialist and the fire alarm system specialist are to co-operate in designing and testing all required interfaces between the PAVA system and the fire alarm system.
- 3 HVAC System:
 - a Inform the HVAC contractor of the peak and diversified thermal outputs of equipment and the safe operating temperature range of the equipment.
- 4 Architectural Integration:
 - a Co-ordinate with the architect to ensure that equipment is appropriately integrated with the building design and co-ordinated with the ceiling layouts and the other elements incorporated into the ceilings. This will include:
 - HVAC grilles and diffusers
 - Fire alarm sounder and detectors
 - Sprinkler heads
 - Luminaires
 - b Supply equipment in colours and finishes as required by the architect. Wherever possible design to ensure that all equipment, cables and ancillary items are of discreet appearance or hidden from view where appropriate
 - c Where particular acoustic conditions/materials are required to optimise performance of sounders, the specialist is required to inform the architect or the architectural designer of any particular requirements that are required to meet the acoustic performance.

W50.1.10 EXTRA MATERIALS

- A Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Provide the following number of spare parts for each different type installed:
- 1 Remote Indicating Lamp Units: 10
 - 2 Break glass units: 5
 - 3 5% (with a minimum of 3) of each type of smoke detector head
 - 4 3% (with a minimum of 2) of each type of other detector.
 - 5 Detector Bases: 2% with a minimum of 2
 - 6 Keys and Tools:
 - a One extra set for access to locked and tamper proofed components
 - 7 Audible and Visual Notification Appliances: 10
 - 8 Fuses: 10

W50.2 PART 2 – PRODUCTS

W50.2.1 FIRE ALARM SYSTEM CONFIGURATION

- A The FDAS is to comprise a 24Vdc analogue addressable, electrically supervised, zone annunciated fire detection and alarm system. The FDAS system consists of the main fire alarm control panel (FAP) and, for larger projects, a number of repeater panels (FAR). Where the site comprises a number of buildings provide a main panel for each building. The system is to be standalone, open protocol and networked so that panels and networking peripherals are connected together using standard or enhanced fire-resistant cables.
- B Network: Provide the network complete with communications cards in the panels to allow connection of up to 200 control panels, remote terminals, mimic displays or other peripheral devices. The network to provide peer-to-peer operation and have a fault tolerant capability. The time to propagate a fire alarm condition across the network is not to exceed 3 seconds.
- C A single FAP to have the capability for configuration and operation of 200 fire alarm zones. In a network system, the overall system to have the capability to:
- 1 Control and monitor minimum 160 zones (per panel)
 - 2 Control and monitor 1000 zones
 - 3 Download device information
 - 4 Extract event log information
 - 5 Download device history
 - 6 View drift (contaminated) status of detectors
 - 7 Network simulation and test facility.
- D To permit future expansion design the system such that no more than 90% of the available signalling / detection loop capacity is employed.
- E Where indicated on the drawings and section B of this specification additionally provide a central graphical user interface (GUI) for permanently manned facilities that permits control, monitoring reporting and logging of the system condition and operating parameters.
- F Battery/Charger: A charger together with maintenance free sealed lead acid cells shall be supplied suitable for integral mounting within the processor unit, which should be BS EN54-4 compliant.
- G Standby Power supplies: Battery capacity to be provided as follows in accordance with BS 5839-1
- 1 Category L (no standby generator): 24 hours plus 30 minutes evacuation signal
 - 2 Category L (with standby generator): 6 hours plus 30 minutes evacuation signal.
 - 3 Category P (where continuously manned or remote monitoring): 24 hours + 30 minutes for all devices
 - 4 Category P (unmanned): 24 hours more than unoccupied period or maximum of 72 hours + 30 minute for all devices.
- H Primary power for the fire alarm control panel and the secondary power battery chargers shall be obtained from a dedicated emergency power circuit. Circuit breakers shall be fitted with a suitable guard, requiring removal of a screw to open, and used only for fire alarm. Each circuit used for fire alarm purposes shall be permanently labelled for function.
- I Primary Power: 24-V dc obtained from 230-Vac 50Hz service and a power-supply module. Initiating devices, notification appliances, signalling lines, trouble signals, supervisory signals supervisory and digital alarm communicator transmitters and digital alarm radio transmitters shall be powered by 24-V dc source:
- 1 Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- J Fire alarm control panel connection unit to be wired from the main switchboard supply in accordance with BS5839 Part 1 via a dedicated circuit protection device. The protection device shall be provided with a durable label FIRE ALARMS - DO NOT SWITCH OFF'.

- K Protect the fire alarm control panel from transient over voltages and supply disturbances via a surge protection device. The surge protection devices shall be a type 3 rated device in accordance with BS EN 60309. Locate the surge protection device in a dedicated recess directly above the fire alarm control panel or directly above the control panel in an accessible ceiling void. The protection unit shall be supplied complete with suitable enclosure. Surge protection device to be manufactured by Furse or Dehn UK or equal approved.

W50.2.2 FIRE ALARM CONTROL PANEL (FAP)

- A The FAP is the central controller of the complete FDAS system. Design the panel to:
- 1 receive and process analogue information from the detection devices,
 - 2 provide audible and visual indication of alarm and other conditions to the user,
 - 3 automatically initiate alarm response sequences
 - 4 provide the user interface for interrogation and user programming of the system.
- B Updates to the FAP operating software to be simple to undertake without the need for replaceable components. Store the operating program and configuration memory in a non-volatile memory without the need for batteries to retain the information. Incorporate within the FAP separate microprocessors for signalling loop control and central operation.
- C FAP is to be fully expandable from 1-4 loops and be complete with:
- 1 Microprocessor: fully programmable on site
 - 2 High contrast high resolution LCD display
 - 3 Tactile keyboard
 - 4 4 sounder circuits
 - 5 20 programmable zonal LEDs with slide in labels
 - 6 25 system LEDs for information
 - 7 4 programmable function buttons
- D FAP to provide a facility from which:
- 1 controls can be operated,
 - 2 manual operations can be carried out,
 - 3 indications are audible and/or visible
 - 4 system information can be obtained.
 - 5 All fault conditions (except CPU System Fault) shall be non-latching.
 - 6 All input devices to have the capability of being latching or non-latching (except when configured for Fire Alarm input)
- E Ensure that fire alarm condition is always indicated without any prior manual intervention at the FAP. FAP to indicate the following functional conditions in line with BS EN 54-2
- 1 Quiescent condition,
 - 2 Fire alarm condition,
 - 3 Fault warning condition
 - 4 Disablement condition.
- F FAP to provide Monitoring for all:
- 1 signalling loops,
 - 2 alarm devices
 - 3 output and auxiliary supply output circuits to monitor voltage, current load, etc.
 - 4 Diagnostic monitoring of the signalling loop return current pulses for detection of:
 - a Open circuit
 - b Short circuit
 - c Continuous checking for:
 - Increase in resistance

- Loose terminations
- Partial shots

G FAP to incorporate a real-time clock for

- 1 time stamping of events in the event history log
- 2 scheduling of time related functions.
- 3 configuring up to 10 independent time clocks. Each time clock to be capable of up to two active time periods for each day of the week

H The FAP equipment to provide the capability for:

- 1 a two-stage alarm sounder facility that can be programmed, either on a zonal basis or common system basis.
- 2 Three possible sound output signals:
 - a Alert: Pulsed tone (1s ON, 1s OFF)
 - b Evacuate continuous tone
 - c User definable tone for specialised events

I FAP to provide a user interface with the following features and capabilities in accordance with the requirements of BS EN 54-2

- 1 Base Technology: Dual flash-based processors with real-time clock, trace diagnostics, programmable languages and character sets
- 2 Display: White backlit 240 x 64 graphical LCD
- 3 LED Indicators:
- 4 Controls: Alpha numeric keypad permitting Navigation, Reset, Mute, Silence, Resound, Evacuate, and 4 x Programmable Push Buttons
- 5 Protocols: Open type including Apollo (Xp95 / Discovery), Argus Vega, Hochiki ESP, Nittan Evolution
- 6 Number of Fire Zones: 1000 (200 per individual panel)
- 7 Number of Loops: Dedicated 1-4 loop control panel
- 8 Devices per loop: Protocol dependent
- 9 Loop Current: 500mA per loop
- 10 On-Board Sounder Circuits: 4 x 1 Amp programmable
- 11 On-Board Relays: 2 x 1 Amp 30v AC/DC programmable (10mA, 5v min) - expandable to 4
- 12 Auxiliary Supply: 1 x 24v 500mA
- 13 Programmable Input: 1 x monitored programmable input on-board
- 14 Programmable Key Switch Inputs: 8-volt free inputs
- 15 Total Available Output Current: 5A maximum available for loop current + sounder outputs + auxiliary supply
- 16 Mains Supply: 200 - 240v 47-63 Hz AC (+10%, -15% tolerance) 1.4A max
- 17 Charger Current: 2A temperature compensated
- 18 Serial ports: 1 x on-board RS232 connection for PC, modem, IP or portable printer
- 19 USB Interface: 1 x USB B type connection for PC communication
- 20 Programming: On-board keypad or PC running Windows tools
- 21 Event Log: 5000 Event & Diagnostic + 500 Fire
- 22 Networking: Plug in network card
- 23 Approvals: BSEN 54-2, BS EN 54-4: & BS EN 54-13:

J Provide Windows based PC software programs to permit the following parameters to be set:

- 1 System
 - a Produce a configuration file which contains data for up to 64 control panels connected together as a network.
 - b Set cause and effect tables for any device to operate devices or functions on any panel or panels connected to the network.
 - c Upload and view graphically the configuration from a single panel or entire network of panels.
- 2 Control panel

- a Panel name (network identity, fifteen characters minimum)
 - b Panel text (comfort message or service company forty characters minimum)
 - c Change code numbers for access levels two and three.
 - d Select sounder ringing mode as common, zonal or two stage
 - e Select first and second stage delay times for each sounder output to between zero and five minutes.
 - f Set number of loops on panel as one, two or four
 - g Set number of zones on panel as 0,16, 48 or 96
 - h Set loop sounder volume globally
 - i Set start and end times for day night mode for each day of the week
- 3 Detectors
- a Allocate a zone
 - b Set a delay before the panel responds to a fire signal
 - c Indicate pre-alarm
 - d Set day sensitivity and night sensitivity separately
 - e Address loop powered base sounders
 - f Allocate a forty-character location text message
- 4 Call points
- a Allocate a zone
 - b Allocate a forty-character location text message
- 5 Switch units (input)
- a Allocate a zone for each input and the device itself
 - b Define input action as fire, fault, pre-alarm, technical alarm, evacuate, alert, security alarm, silence alarm, reset, transparent, disablement or test mode.
 - c Change the input action message from the default to any one of the above or to any one of a user defined library of 10 additional action messages.
 - d Set a delay before the panel responds to a fire signal
 - e Select whether the input requires the control panel to be reset or is self-clearing upon removal of the input
 - f Allocate a forty-character location text message
- 6 Relay or sounder units (output)
- a Allocate a zone for each input and the device itself
 - b Define whether the device responds to evacuate inputs, as a sounder (default ringing), is silenceable, needs to be reset or produces a single pulsed operation of between one and five seconds (programmable)
 - c Has a delay before operating (zero to five minutes)
 - d Allocate a forty-character location text message
- 7 Loop powered sounders and beacons
- a Allocate a zone
 - b Define whether the device responds to evacuate inputs, as a sounder (default ringing), is silenceable or needs to be reset.
 - c Has a delay before operating (zero to five minutes)
 - d Allocate a forty-character location text message
- 8 Configuration of panels and the network
- a Cause and effect configuration
 - b Import/export information and print configuration reports
- 9 cause and effect operation for on a zonal or common basis
- a phased evacuation and output control operations (2 stage alarm)
 - b Facility to assign each output device to one of 200 output groups, each output group operation being programmable as to response on a zone by zone basis for:
 - fire,
 - double knock fire,
 - pre-alarm,
 - fault, enablement or disablement conditions
 - up to 21 programmable ringing styles with programmable delays and pulsing tones.

- 10 Service software from which;
- controls can be operated,
 - manual operations can be carried out,
 - Enable/disable inputs by zone:
 - All inputs
 - Selected inputs
 - Only automatic inputs
 - Only manual inputs
 - All other inputs
 - Enable/disable outputs:
 - Disable by output purpose
 - Sounders
 - Relays
 - Beacons
 - Fire routing
 - Fault routing
 - pager
 - indications are audible and/or visible
 - system information can be obtained.
 - General event logs
 - Fire event logs
 - Sensitivity adjustment of settings for all detection devices based on a time clock can be made.
 - Selection of device modes for both active and inactive time periods for multi-sensor detectors.

K Panel construction:

- Enclosure: Steel IP30 finished to manufacturer's standard unless indicated otherwise in section B or the drawings
- Metalwork Options: Flushing bezel, battery box, utility enclosure, termination enclosure and rack mount
- Capable of surface or semi-flush mounting.
- Complete with sufficient 20mm knockouts for all likely wiring requirements.
- Enclosure opening: key or special tool.

L Panel Indications: FAP to monitor the status of all devices on the addressable loops for fire, short-circuit fault, open-circuit fault, incorrect addressing, unauthorised device removal or exchange, pre-alarm condition and contaminated detector condition. The FAP to also monitor the status of internal connections and interfaces including charger and batteries. Provide the following discrete visual indications:

1 POWER ON:	green LED indicator
2 FIRE ALARM:	red LED indicator
3 PRE-ALARM:	amber LED indicator
4 ON TEST:	amber LED indicator
5 BUZZER SILENCED:	amber LED indicator
6 DELAY ACTIVE:	amber LED indicator
7 MORE EVENTS:	amber LED indicator
8 GENERAL DISABLEMENT:	amber LED indicator
9 GENERAL FAULT:	amber LED indicator
10 POWER FAULT:	amber LED indicator
11 SYSTEM FAULT:	amber LED indicator
12 SOUNDER FAULT/DISABLED	amber LED indicator

M Remote Dial-up: Provide a modem to enable full dial-up capability to the FAP. This software package should enable remote access to interrogate and inspect the operation of the FAP, retrieve panel status and historic event log.

- N Remote Terminals: Provide remote access to monitor (Remote Display Terminal) or monitor / control (Remote Control Terminal) operation of the installation. The Remote-Control Terminal to provide the same display, indication and buttons as the FAP.

W50.2.3 GRAPHICAL USER INTERFACE

- A Where indicated on the drawings and/or section B of the specification provide a Graphical User Interface (GUI) to provide a completely interactive user interface for the FDAS with the following minimum features:
- 1 Display of:
 - a All the information from the FAP:
 - b Fire Alarm zone status
 - c Device specific custom messages for each device
 - d Active graphic for device when event is registered
 - 2 Graphics system to monitor:
 - a all alarms
 - b circuit/point activations
 - c all faults
 - 3 Graphical Displays: Capability
 - a Floor plans (minimum 200)
 - b Floor plans linked to alarm event location
 - 4 History log
 - a For central storage of all events
 - b Facility to isolate events detected by any fire alarm control panel
 - c Facility to enable, disable, or clear events with password access
 - d Retention of information on power failure or fire alarm reset
 - e Printable by:
 - Event type
 - Date, Date range
 - Time, time range
 - Device address, device address range
 - Device type, device location
 - Text description
 - 5 Automatic Streaming of video feeds from site-based CCTV cameras upon alarm annunciation
 - 6 Ability to connect to the site BMS system via Modbus BACnet or other approved protocols.
- B System configuration to be menu driven and capable of being operated by a person with no previous computer programming experience.
- C Provide the ability to assume terminal control of any network connected local control system, reading sensitivity, displaying system information and initiating commands when accessed by approved passwords.
- D Provide the ability to enter operator responses to alarms, fault conditions or other reported incidents
- E Provide secure password access to all features, functions and data contained in the overall BMS. Access all data using a standard web browser such as Internet Explorer. Incorporate 3 levels of access authority:
- 1 Level 1: Full access for fault monitoring, adjustment of sensitivity, time schedules (full access rights set by FDAS manager)
 - 2 Level 2: Limited access to view and clear fault monitoring, adjustment of time schedules (permissions adjustable by FDAS manager)
 - 3 Level 3: Limited access to view any system status
- F Provide recommendations for password naming and frequency of password change requests as part of the overall cyber security measures to be incorporated into the O&M manuals and training documentation.

W50.2.4 PRINTER

- A Where a GUI is indicated provide a printer in the GUI location complete with a complete box of spare paper provided at hand-over. Set up the printer to record:
- 1 Event type
 - 2 Date, Date range
 - 3 Time, time range
 - 4 Device address, device address range
 - 5 Device type, device location
 - 6 Text description
 - 7 Time alarm condition cleared
- B Printer minimum specification:
- 1 Printer: Colour, laser-jet type as follows:
 - a Print Head: 1200 x 1200 dpi resolution
 - b Paper Handling: Minimum of 250 sheet trays
 - c Print Speed: Minimum of 270 characters per second.

W50.2.5 FIRE ALARM REPEATER PANELS

- A Fire alarm repeater panels (FAR) are to be of the active type (with controls) thus displaying (repeating) the operational status of the main control panel (FAP) and also permitting the control the FAP using the following key enabled functions for the particular sector in which the panels is located:
- 1 Sound Alarms: Evacuate building
 - 2 Silence/Resound: turns off activated sounders or re-activates
 - 3 Mute buzzer: Silences internal buzzer
 - 4 Accept: Accept a stage 1 investigation delay alarm
 - 5 System Reset: Cancels all alarm conditions and re-sets the panel
 - 6 Self-test: Initiates self-test functions
- B The FAR sector-based control keys allow other networked panels to selectively respond to controls as programmed. E.g. on a site with multiple buildings, a user may be allowed to silence and reset fires originating in their own building. Fires originating from other buildings are displayed but cannot be reset.
- C FAR is have the following functionality:
- 1 Fully on-site programmable via onboard alphanumeric keypad or PC configuration tools.
 - 2 View all information from across the network
 - 3 flash memory and an advanced graphical display for configuration
 - 4 Networked for System Display or Control
 - 5 Programmable switch input
 - 6 Graphical LCD display
 - 7 Slide-in labels
 - 8 Compact
 - 9 24V DC operating voltage
- D The repeater panels are to be of the same manufacture as the main fire alarm panels and should be constructed as follows with the following functionality
- 1 Display: White backlit 240x64 graphical LCD
 - 2 LED Indicators (minimum):
 - a 2 red (1 x Fire, 1 x Alarm),
 - b 1 green (Power)
 - c 3 amber (Fault & System)
 - 3 Keypad: Alpha numeric keypad, navigation keys & onboard buzzer mute facility
 - 4 Controls: System keys for Mute, reset, Silence, Resound

- 5 Key-Switch Input: Optional level 2 access enable key switch
- 6 Power Supply Input: 24 VDC, 115mA (/FT: 150mA) operating range 15-30V
- 7 External Supply Monitoring: Monitored external fault input
- 8 Number of Fire Zones: 2000
- 9 USB/Serial Ports: 1 x USB
- 10 Programming: Via onboard keypad or PC running Windows tools
- 11 Enclosure: Steel IP30
- 12 Cable Entry: 20mm knockouts. 4 x top and 4 x rear
- 13 Colour and finish: Manufacturer's standard or special as indicated in section B
- 14 Metalwork Options: Semi flushing bezel, special finishes including Stainless & Chrome

W50.2.6 ADDRESSABLE INTELLIGENT MOUNTING BASES

- A All detectors and sounders to be mounted on common intelligent, addressable, isolatable bases so that detectors and sounders may be interchanged with different devices and individually monitored and addressed.
- B The base to be permanently fixed to the ceiling/wall and connected to the detector by a plug and socket arrangement, when pressure is applied the base shall remain in place but the detector element shall release - indicating a fault condition on the fire system.
- C The isolating bases sense and isolate short circuit faults on the loops and spurs so that no device is lost in the event of a single short circuit. In short circuit conditions the integral amber LED is illuminated.
- D Isolating Base technical details:
 - 1 Minimum supply voltage in normal operating conditions: 17 V dc
 - 2 Maximum supply voltage: 28 V dc plus 9 V dc protocol pulses
 - 3 Isolation indicator Amber LED, lit continuously in isolation condition
 - 4 Current consumption
 - a at 18 V dc: 23 μ A
 - b at 28 V dc: 43 μ A
 - c at 18 V dc and adjacent sector isolated: 4mA
 - 5 Maximum line current
 - a non-isolating continuous: 1.0A
 - b transition into isolation: 3.0A
 - 6 Operating temperature: -20°C to +60°C
 - 7 Storage temperature: -30°C to +80°C
 - 8 Humidity (no condensing or icing): 0% to 95% relative humidity
 - 9 Standards and approvals: MED, LR and ABS
 - 10 Approved use: Indoor use only
 - 11 Dimensions: 100 mm diameter x 24 mm
 - 12 Earthing terminal
 - 13 Materials:
 - a Body: White polycarbonate moulding
 - b Terminals: Nickel plated stainless steel

W50.2.7 ANALOGUE ADDRESSABLE OPTICAL SMOKE DETECTORS

- A Check suitability for application and provide optical smoke detectors in accordance with the layout drawings (where provided) and/or as required by BS 5939-1.
- B Design for connection to a two-wire loop carrying both data and 17V-28V dc supply. Mount detectors on compatible intelligent bases. Detectors to have the following features:
 - 1 5 No. BS EN54 approved response modes related to sensitivity to fire.
 - 2 2 No. Integral LED indicators for illumination by FACP to indicate those in alarm.

- 3 Flashing LED: to indicate each time detector is polled
- 4 Remote test feature: Enabled from FACP
- 5 Drift compensation: maintains sensitivity even with dust contamination

C Optical smoke detector technical details:

- 1 Detection principle: Photo-electric detection of light scattered in a forward direction by smoke particles
- 2 Chamber configuration: Horizontal optical bench housing an infrared emitter and sensor arranged radially to detect forward scattered light
- 3 Sensor: Silicon PIN photodiode
- 4 Emitter: GaAlAs infra-red light emitting diode
- 5 Sampling frequency: Once per second
- 6 Supply Wiring: Two wire supply, polarity insensitive
- 7 Digital communication: Open protocol 5–9 V peak to peak
- 8 Operating voltage: 17 V - 28 V dc
- 9 Quiescent current: 200- 300 μ A
- 10 Power-up surge current 1mA
- 11 Maximum power-up time 10 seconds
- 12 Alarm indicator: Two clear light emitting diode (LED) illuminating red in alarm. Optional remote LED
- 13 Alarm current, LED illuminated: 3.5-5 mA
- 14 Remote output characteristics: Connects to positive line through 4.5 k Ω (5 mA maximum)
- 15 Clean-air analogue signal value: 23 +4/-0
- 16 Alarm level analogue value: 55
- 17 Operating temperature: -40°C to +70°C
- 18 Storage temperature: -40°C to +70°C
- 19 Humidity: 0% to 95% RH (no condensation or icing)
- 20 Effect of atmospheric pressure: None
- 21 Effect of wind: None
- 22 Vibration, impact & shock: BS EN54 - 7
- 23 IP Rating: IP44
- 24 Standards & approvals: BS EN 54-7, IEC 61508 -1, 2, LPCB 041
- 25 Dimensions: 100 mm diameter x 40-50 mm height
- 26 Housing: White flame-retardant polycarbonate/ABS
- 27 Terminals: Nickel plated stainless steel

- D Provide duct mounted smoke detectors in any ducts serving air handling units that recirculate room air and where indicated on the drawings or BS 5839-1. Detectors to be suitable for mounting on manufacturer's standard bases

W50.2.8 ANALOGUE ADDRESSABLE IONISATION SMOKE DETECTOR

- A Check suitability for application and provide ionisation smoke detectors in accordance with the layout drawings (where provided) and/or as required by BS 5839-1.
- B Design for connection to a two-wire loop carrying both data and 17V-28V dc supply. Mount detectors on compatible intelligent bases. Detectors to have the following features:
- 1 5 No. BS EN54 approved response modes related to sensitivity to fire.
 - 2 2 No. Integral LED indicators for illumination by FACP to indicate those in alarm.
 - 3 Flashing LED: to indicate each time detector is polled
 - 4 Remote test feature: Enabled from FACP
 - 5 Drift compensation: maintains sensitivity even with dust contamination
 - 6 Tested: Health Protection Agency
 - 7 Regulations:
 - a Environmental Permitting Regulations 2016
 - b Ionising Regulations 1999

C Optical smoke detector technical details:

- 1 Detection principle: Ionisation Chamber
- 2 Chamber configuration: Twin compensating chambers using one single sided Ionisation radiation source
- 3 Radioactive Isotope: Americium 241
- 4 Activity: 33.3 kBq, 0.9 µCi
- 5 Sampling frequency: Continuous
- 6 Supply Wiring: Two wire supply, polarity insensitive
- 7 Operating voltage: 17 - 28 V dc
- 8 Digital communication: Open protocol, 5-9V peak to peak
- 9 Quiescent current: 300µA
- 10 Power-up surge current: 1mA
- 11 Maximum power-up time: 10 seconds
- 12 Alarm indicator: 2 Red light emitting diodes (LEDs), Optional remote LED
- 13 Alarm current LED illuminated: 3.5 mA
- 14 Remote output characteristics: Connects to positive line through 4.5 kΩ (5 mA maximum)
- 15 Clean-air analogue signal value: 23 +4/-0
- 16 Alarm level analogue value: 55
- 17 Operating temperature: -30°C to +70°C
- 18 Storage temperature: -40°C to +80°C
- 19 Humidity: 0% to 95% RH (no condensation or icing)
- 20 Effect of temperature: Less than 10% change in sensitivity overstated range
- 21 Effect of atmospheric pressure: suitable for installation up to 2,000 m above sea level
- 22 Effect of wind speed: Less than 20% change in sensitivity at speeds up to 10 m/s.
- 23 Note: slow changes in ambient conditions will automatically be compensated and will not affect sensitivity
- 24 Vibration, impact & shock: BS EN 54-7
- 25 IP Rating: IP44
- 26 Standards & approvals: BS EN 54-7, IEC 61508-1, 2, LPCB 041
- 27 Dimensions 10 mm diameter x 40-50 mm height
- 28 Housing: White flame-retardant polycarbonate
- 29 Terminals: Nickel plated stainless steel

W50.2.9 ANALOGUE ADDRESSABLE HEAT DETECTOR

A Check suitability for application and provide heat detectors in accordance with the layout drawings (where provided) and/or as required by BS 5839-1. The following types may be selected depending upon the application:

- 1 Rate of Rise type:
- 2 Fixed temperature type

B Design for connection to a two-wire loop carrying both data and 17V-28V dc supply. Mount detectors on compatible intelligent bases. Detectors to have the following features:

- 1 5 No. BS EN54 approved response modes related to sensitivity to fire.
- 2 2 No. Integral LED indicators for illumination by FACP to indicate those in alarm.
- 3 Flashing LED: to indicate each time detector is polled
- 4 Remote test feature: Enabled from FACP
- 5 Drift compensation: maintains sensitivity even with dust contamination

C Heat detector technical details:

- 1 Detection principle: Heat sensitive resistance
- 2 Sensor: Single NTC thermistor
- 3 Sampling frequency: Continuous

- 4 Supply Wiring: Two wire supply, polarity insensitive
- 5 Operating voltage: 17 - 28 V dc
- 6 Communication protocol: Open protocols 5 V to 9 V peak to peak
- 7 Quiescent current: 400 μ A
- 8 Power-up surge current: 1mA
- 9 Maximum power-up time: 10 seconds
- 10 Alarm indicator: Two Red light emitting diodes (LEDs) Optional remote LED
- 11 Alarm level analogue signal value: 55
- 12 Alarm LED current: 3.5 mA
- 13 Remote output characteristics: Connects to positive line through 4.5 k Ω (5 mA maximum)
- 14 Storage temperature: -40°C to 80°C
- 15 Operating temperature: 100°C max
- 16 Humidity (no condensation or icing): 0% to 95% RH
- 17 Effect of atmospheric pressure: None
- 18 Effect of wind speed: None in fixed temperature use
- 19 Vibration, impact & shock: BS EN 54-5
- 20 IP Rating: IP54
- 21 Standards & approvals: EN 54-5, IEC 61508-1, 2, LPCB 041
- 22 Dimensions: 100 mm diameter x 40-50 mm height
- 23 Housing: White flame-retardant polycarbonate
- 24 Terminals: Nickel plated stainless steel

W50.2.10 OPTICAL/HEAT MULTISENSOR ANALOGUE ADDRESSABLE DETECTORS

- A Check suitability for application and provide combined optical and heat detectors in accordance with the layout drawings (where provided) and/or as required by BS 5839-1.
- B Design for connection to a two-wire loop carrying both data and 17V-28V dc supply. Mount detectors on compatible intelligent bases. Detectors to have the following features:
 - 1 5 No. BS EN54 approved response modes related to sensitivity to fire.
 - 2 2 No. Integral LED indicators for illumination by FACP to indicate those in alarm.
 - 3 Flashing LED: to indicate each time detector is polled
 - 4 Remote test feature: Enabled from FACP
 - 5 Drift compensation: maintains sensitivity even with dust contamination
- C Optical/Heat detector technical details:
 - 1 Detection principle:
 - a Smoke: Photo-electric detection of light scattered by smoke particles
 - b Heat: Temperature-dependent resistance
 - 2 Supply Wiring: Two wire supply, polarity insensitive
 - 3 Operating voltage: 17 - 28 V dc
 - 4 Communication protocol: Open Protocol 5-9 V peak to peak
 - 5 Quiescent current: 400 μ A
 - 6 Power-up surge current: 1 mA
 - 7 Maximum power-up time: 10 seconds
 - 8 Alarm current, LED illuminated: 3.5 mA
 - 9 Remote output characteristics: Connects to a positive line through 4.5 k Ω (5 mA maximum)
 - 10 Clean air analogue signal value: 23 +4/-0
 - 11 Alarm level analogue value: 55
 - 12 Alarm indicator: Two colourless LEDs, illuminated red in alarm. Optional remote LED
 - 13 Operating temperature: -40°C to 70°C
 - 14 Humidity: 0% to 95% RH (no condensation or icing)
 - 15 Effect of temperature on optical sensor: None
 - 16 Effect of wind speed on optical sensor: None

- 17 Vibration, impact & shock EN 54-7
- 18 IP Rating: IP44
- 19 Standards & approvals: BS EN 54-5, BS EN 54-7 and IEC61508-1,2, LPCB 041
- 20 Dimensions 100 mm, diameter x 50-60 mm height
- 21 Housing: White flame-retardant polycarbonate
- 22 Terminals: Nickel plated stainless steel
- 23 Smoke element only Chamber configuration: Horizontal optical bench housing infra-red emitter and sensor, arranged radially to detect forward scattered light
- 24 Sensor: Silicon PIN photodiode
- 25 Emitter: GaAlAs infra-red light emitting diode
- 26 Sampling frequency: Once per second

W50.2.11 INTRINSICALLY SAFE OPTICAL SMOKE DETECTORS

- A Check suitability for application and provide optical smoke detectors in accordance with the layout drawings (where provided) and/or as required by BS 5839-1.
- B Design for connection to a two-wire loop carrying both data and 14V-22V dc supply. Mount detectors on compatible intelligent bases. Detectors to have the following features:
 - 1 Certified to: ATEX Directive 2014/34/EU
 - 2 Classification:
 - a Ex ia IIC T4 GA ($\leq +60^{\circ}\text{C}$),
 - b Ex ia IIC T5 GA ($\leq +45^{\circ}\text{C}$)
 - 3 1 No. Integral LED indicator, clear in standby and red in alarm.
 - 4 Drive point for remote LED indication
- C Optical smoke detector technical details:
 - 1 Detection principle: Photo-electric detection of light scattered in a forward direction by smoke particles
 - 2 Chamber configuration: Horizontal optical bench housing an infrared emitter and sensor arranged radially to detect forward scattered light
 - 3 Sensor: Silicon PIN photodiode
 - 4 Emitter: GaAlAs infra-red light emitting diode
 - 5 Sampling frequency: Once per second
 - 6 Sensitivity: Nominal response threshold value 0.12 dB/m when measured in accordance with EN 54-7
 - 7 Supply Wiring: Two wire supply, polarity insensitive
 - 8 Digital communication: Open protocol 5-9 V peak to peak
 - 9 Operating voltage: 14 V - 22 V dc
 - 10 Quiescent current: 340 μA
 - 11 Power-up surge current 1mA
 - 12 Maximum power-up time 10 seconds
 - 13 Alarm indicator: Clear light emitting diode (LED) illuminating red in alarm.
 - 14 Alarm current, LED illuminated: 3.5-5 mA
 - 15 Remote LED Current: 1mA (internally limited)
 - 16 Clean-air analogue signal value: 23 +4/-0
 - 17 Alarm level analogue value: 55
 - 18 Operating temperature: -40°C to $+70^{\circ}\text{C}$
 - 19 Storage temperature: -40°C to $+70^{\circ}\text{C}$
 - 20 Humidity: 0% to 95% RH (no condensation or icing)
 - 21 Effect of atmospheric pressure: None
 - 22 Effect of wind: None
 - 23 Vibration, impact & shock: BS EN54 - 7
 - 24 IP Rating: IP23D
 - 25 Standards & approvals: BS EN 54-7, IEC 61508 -1, 2, LPCB 041, BS EN 60079-11
 - 26 Dimensions: 100 mm diameter x 40-50 mm height

- 27 Housing: White flame-retardant polycarbonate/ABS
- 28 Terminals: Nickel plated stainless steel

W50.2.12 INTRINSICALLY SAFE HEAT DETECTOR

- A Check suitability for application and provide heat detectors in accordance with the layout drawings (where provided) and/or as required by BS 5839-1. The device monitors heat using a single thermistor network which provides a voltage output proportional to the external air temperature.
- B Design for connection to a two-wire loop carrying both data and 14V-22V dc supply. Mount detectors on compatible intelligent bases. Detectors to have the following features:
 - 1 Certified to: ATEX Directive 2014/34/EU
 - 2 Classification:
 - 3 Ex ia IIC T4 GA ($\leq +60^{\circ}\text{C}$),
 - 4 Ex ia IIC T5 GA ($\leq +45^{\circ}\text{C}$)
 - 5 1 No. Integral LED indicator, clear in standby and red in alarm.
 - 6 Drive point for remote LED indication
- C Heat detector technical details:
 - 1 Detection principle: Linear approximation over temperature range 25°C to 90°C
 - 2 Sensor: Single NTC thermistor
 - 3 Sampling frequency: Continuous
 - 4 Sensitivity:
 - a 25°C to 90°C : $1^{\circ}\text{C}/\text{count}$
 - b -20°C returns 8 counts
 - 5 Supply Wiring: Two wire supply, polarity sensitive
 - 6 Operating voltage: 14 - 22 V dc
 - 7 Communication protocol: Open protocols
 - 8 Quiescent current: 300 μA
 - 9 Power-up surge current: 1mA
 - 10 Maximum power-up time: 4 seconds
 - 11 Alarm indicator: Red light emitting diodes (LED)
 - 12 Alarm level analogue signal value: 25 ± 5 counts
 - 13 Alarm LED current: 2.0 mA
 - 14 Storage temperature: -30°C to 80°C
 - 15 Operating temperature: -20 to $+40^{\circ}\text{C}$ max
 - 16 Humidity (no condensation or icing): 0% to 95% RH
 - 17 Effect of atmospheric pressure: None
 - 18 Effect of wind speed: None in fixed temperature use
 - 19 Vibration, impact & shock: BS EN 54-5
 - 20 IP Rating: IP53
 - 21 Standards & approvals: EN 54-5, IEC 61508-1, 2, LPCB 041
 - 22 Dimensions: 100 mm diameter x 40-50 mm height
 - 23 Housing: White flame-retardant polycarbonate
 - 24 Terminals: Nickel plated stainless steel

W50.2.13 BEAM DETECTORS

- A Check suitability for application and provide beam smoke detectors in accordance with the layout drawings (where provided) and/or as required by BS 5839-1. Detectors to be of the linear optical reflector type.
- B Design for connection to a two-wire loop carrying both data and 15V-32V dc supply. Mount detectors on compatible back boxes. Detectors to have the following features:
 - 1 Complies with BS EN 54-12 +A1

- 2 Complete with test facility
 - 3 Range: 5-100m
 - 4 4No. fixed sensitivity/threshold levels
 - 5 2No. automatic variable sensitivity modes
 - 6 Loop powered
 - 7 Adjustment: ceiling mounted;
 - a Vertical: 28°
 - b Horizontal: 360°
 - 8 Adjustment: Wall mounted:
 - a Vertical: 23°
 - b Horizontal: 90°
- C Units comprise combined transmitter and a receiver unit that can be directly connected to an analogue loop circuit.
- D Beam detector technical details:
- 1 Operating voltage: 24Vdc nominal
 - 2 Standby current: 2mA
 - 3 IP rating: IP54
 - 4 Temperature range: -30°C to +55°C
 - 5 Colour: White trim, black box.
 - 6 Material: Fire retardant polycarbonate/ABS.
 - 7 Reflector: 5-100m range
 - 8 Heater kits for beam and reflector
 - 9 LPCB certified

W50.2.14 INFRA RED FLAME DETECTORS

- A Infra-red flame detectors to be capable of detecting infra-red radiation produced by flaming fires involving carbonaceous materials. The Intelligent Base Mounted Flame Detectors are loop-powered and require no external supply. A remote LED alarm indication may be connected to the fame detector. The device incorporates the following features:
- 1 3No. IR sensors for different wavelength sensing
 - 2 Responds to stationary fames with no flicker
 - 3 Sensitive to low frequency flickering IR radiation emitted by flames during combustion
 - 4 Compact flame detector which fits into intelligent system bases
 - 5 Loop powered
 - 6 False alarms due to factors such as flickering sunlight are avoided by a combination of filters and signal processing techniques
 - 7 Suitable for indoor or outdoor applications
- B The Intelligent (Exd) Flameproof IR3 Detector is designed for use in hazardous environments in both indoor and outdoor applications. It is sensitive to low frequency, flickering infra-red radiation emitted by fames during combustion. These detectors are BASEEFA approved and meet the requirements of ATEX Directive 2014/34/EU.
- C Standards:
- 1 ATEX certified: II 2 G D
 - 2 CENELEC/IEC certified: EEX d - IIC T4 - (Zones 1, 21, 2 and 22)
 - 3 Class 1 sensitivity to BS EN54-10
 - a High- Class1
 - b Low- Class 3
 - 4 LPCB
 - 5 IECEx

6 BASEEFA

D Infra-Red (IR³) Flame detector technical data:

- 1 Supply voltage: 17 - 28 V dc
- 2 Digital communication: Open Protocol compatible
- 3 Protocol peak to peak: 5 - 9 V
- 4 Quiescent current: 2.2 mA
- 5 Remote LED current: 2mA
- 6 Range of view 0.1 m
 - a 0.1m² n-heptane at 25 m
 - b 0.2 m² n-heptane at 35 m
 - c 0.4 m² n-heptane at 45 m
- 7 Alarm current: 4.2 mA
- 8 Surge current: 9 mA (peak) for 85 ms
- 9 Maximum power-up time: 4 seconds
- 10 Remote output characteristics: Connects to positive line through 4.5 k Ω (5 mA maximum)
- 11 Field of view: 90° cone
- 12 Spectral response: 0.75 to 2.7 μ m
- 13 Operating temperature: -40°C to +70°C
- 14 Storage temperature: -40°C to +70°C
- 15 Relative humidity (no condensing or icing): 95% RH
- 16 Standards and approvals: MED and ABS
- 17 IP rating: IP66
- 18 Dimensions 150 mm x 140 mm
- 19 Housing: Copper free Aluminium alloy
- 20 Sensing window: 2 mm Float glass
- 21 Terminals: Nickel plated stainless steel

E Each alarm device shall have the facility to be able to be programmed for operation dependent on occupational requirements. Sounder and beacon operation shall be determined prior to commissioning.

F The detectors shall be supplied complete with mounting bases. The mounting bases shall be capable of being locked in position. They shall be suitable for mounting on standard BESA boxes which shall be flush mounted and trunking accessory boxes.

W50.2.15 CARBON MONOXIDE DETECTOR & SOUNDER BASE

A Check suitability for application and provide carbon monoxide detectors in accordance with the layout drawings (where provided) and/or as required by BS 5839-1 or description within section B. Detectors to incorporate an electrochemical sensor able to detect 3 levels of carbon monoxide and have a minimum life of 6 years. Not to be used to replace smoke or heat detectors.

B Use where required to protect occupants against carbon monoxide produced by incomplete combustion in appliances such as gas fires or boilers. Suitable for smouldering fires and may operate before smoke detectors for this type of fire.

C Design for connection to a two-wire loop carrying both data and 15V-32V dc supply. Mount detectors on compatible intelligent sounder base. Detectors to have the following features:

- 1 Complies with: BFPSA, UL 2075 & 2034
- 2 Built in dedicated microprocessor
- 3 Integral red status LED
- 4 Fully supervised
- 5 Test facility

D CO detector technical details

- 1 CO detected alarm response times: Time weighted average
 - a Within 4 hours: 70ppm
 - b Within 50 minutes: 150ppm
 - c Within 15 minutes: 400ppm
- 2 Voltage: 24V dc
- 3 Power consumption:
 - a Quiescent: 0.4mA
 - b Alarm: 0.7mA
 - c Alarm/LED: 3.5mA
- 4 Sound level: 75/85 dBA at 3m
- 5 Material: Fire retardant polycarbonate/ABS

W50.2.16 ADDRESSABLE SOUNDERS & VISUAL INDICATORS

- A Check suitability for application and provide sounders, sounders and beacons and beacons only in accordance with the layout drawings (where provided) and/or as required by BS 5839-1 to ensure the minimum audibility standards are achieved throughout the project. Provide beacons where there is a risk that the sounders may not be heard above the ambient noise levels. Ensure that the units are suitable for indoor or outdoor applications as indicated. Sounders may be of one the following types as indicated on the drawings and in section B of this specification:
- 1 Multi- tone open area sounder
 - 2 Multi-tone open area sounder with beacon
 - 3 Multi-tone open area beacons
- B Design for connection to a two wire loop carrying both data and 15V-32V dc supply. Mount detectors on common mounting base. Detectors to have the following features:
- 1 Colour: Red or white (refer to section B, but allow for red where not indicated)
 - 2 2 volume settings: 92dBA or 100dBA at 1m
 - 3 Synchronisation of "alert" and "evacuate" tones
 - 4 Individual and group addressing
 - 5 With or without built in isolators
 - 6 Minimum of 3 tones: BS EN 54-3
 - 7 Wire to base
 - 8 Device locking facility
- C Sounder technical details:
- 1 Supply voltage: 18 - 28 V dc (polarity sensitive)
 - 2 Digital communication: Open Protocol compatible
 - 3 Maximum Power consumption
 - a Quiescent: 330 μ A
 - b Switch on surge: 1.2mA for < 1s
 - c Sounder operating: 5mA
 - d sounder beacon+ alarm operating: 9mA
 - e beacon operating: 3.1mA
 - 4 Maximum sounders per loop: as manufacturer's calculations
 - 5 Volume control: 100-92dBA $\pm$ 3 dBA
 - 6 Dimensions (nominal) : 100mm diameter x 100mm deep
 - 7 IP ratings
 - a Indoor: IP 21C
 - b Outdoor: IP 65
- D Operation: The number of sounders used should be sufficient to produce a sound level of 65 dBA or 5 dBA above any other noise level likely to persist for a period longer than 30 sec.

W50.2.17 FIRE ALARM BELL AND VISUAL ALARM DEVICE

- A Check suitability for application and provide fire alarm bells in accordance with the layout drawings (where provided) and/or as required by BS 5839-1 to ensure the minimum audibility standards are achieved throughout the project. Ensure that the units are suitable for indoor or outdoor applications as indicated. Bells to be of the electronic type suitable for integration with the addressable fire alarm system.
- 1 150mm fire alarm bell
 - 2 200mm fire alarm bell
 - 3 Combined bell and Visual Alarm Device
- B Fire alarm Bells: Design for connection to a two-wire loop carrying both data and 15V-32V dc supply. Mount fire alarm bells on mounting base box. Fire Alarm Bells to have the following features:
- 1 Gong Colour: Red
 - 2 Operating power: 11mA
 - 3 Sound output: 100dBA at 1m
 - 4 Certification: LPCB, CE
 - 5 BS EN 54-3
 - 6 Materials: Aluminium
- C Combined Bell & Visual Alarm Device:
- 1 Gong Colour: Red
 - 2 Light Colour: White
 - 3 Supply voltage: 45mA
 - 4 Sound Output: 95 dBA at 1 m
 - 5 Light output: 54.8 Lux
 - 6 Flash rate: selectable 30/60 per minute
 - 7 Materials: Aluminium
 - 8 IP rating:
 - a Indoor: IP21
 - b Outdoor: IP65
- D Operation: The bells/VAD may be operated either from a separate alarm output in the control panel or via an interface on the loop. The number of alarm bells used should be sufficient to produce a sound level of 65 dBA or 5 dBA above any other noise level likely to persist for a period longer than 30 sec.

W50.2.18 REMOTE INDICATOR UNITS

- A Provide remote indicator units to give a remote indication for any detector that may be located in an enclosed or locked compartment.
- B Remote indicator unit to be driven directly from its associated local detector.
- C Provide flush or surface mounted type to suit the location.

W50.2.19 SHORT CIRCUIT ISOLATORS

- A Base mounted isolators are to be provided but where this is not practical provide protection on the addressable loop by the incorporation of short circuit isolator modules. Only the section of the loop between the isolators will be affected.
- B Short circuit isolator module to derive power directly from the loop and provide an LED indication that the module has tripped.

W50.2.20 ADDRESSABLE RELAY INTERFACE UNITS

- A Provide interface units (auxiliary relays) as required to monitor and/or control systems other than addressable equipment, including such items as:
- 1 Sprinkler system panel alarms.
 - 2 Fire/smoke control dampers
 - 3 Conventional fire alarm zones
 - 4 Ventilation systems
 - 5 MCP
 - 6 Fuel system isolation valves
 - 7 Interface with lift control
 - 8 Fire shutters
 - 9 Smoke extraction systems
 - 10 Fire doors
- B Unit to be loop powered and provide:
- 1 2No. Voltage free single pole, changeover relay outputs
 - 2 1 No. monitored switch input
 - 3 1 No. unmonitored, polarised coupled link
 - 4 Bi-directional short circuit isolator
 - 5 Indications: 4 No LEDs Visible through front cover
 - a Relay is set: red LED
 - b Switch input closed: red LED
 - c Fault (open or short circuit): yellow LED
 - d Isolator short circuit fault: yellow LED
- C Technical details:
- 1 Minimum loop operating voltage in normal conditions: 17 V dc
 - 2 Maximum loop operating voltage: 28 V dc
 - 3 Digital communication: Open Protocol
 - 4 Maximum current consumption at 28 V dc, no protocol
 - 5 Switch-on surge, max 150 ms: 3.5 mA
 - 6 Quiescent: 1.25 mA
 - 7 Switch input closed 'switch closed' LED on: 2.5 mA
 - 8 Switch input closed (LED disabled): 1.5 mA
 - 9 Any other condition (max 2 LEDs on): 3.5 mA
 - 10 Relay operated: 2 mA
 - 11 Switch input monitoring voltage: 9 - 11 V dc (open-circuit condition)
 - 12 Maximum cable resistance 50 Ω
 - 13 Relay output
 - a Contact rating (inductive or resistive): 1 A at 30 V ac or dc
 - b Wetting current: 10 μ A at 10 mV dc
 - 14 On resistance: 0.2 4Ω
 - 15 Maximum continuous current: 1 A
 - 16 Maximum switching current: 3 A
 - 17 Operating temperature (ambient): -20°C to 70°C
 - 18 Humidity (no condensation or icing): 0 - 95% RH
 - 19 Shock, vibration and impact: EN54-18
 - 20 IP rating: IP54
 - 21 Standards and approvals: BS EN54-17, BS EN54-18 and IEC61508-1
 - 22 Dimensions: 150 mm x 90 mm x 48 mm
 - 23 Materials Bod: white polycarbonate
- D Provide a backbox for surface or flush mounting indoors depending upon the location

W50.2.21 ADDRESSABLE SWITCH MONITORING MODULE

- A Provide addressable switch monitoring module where required. Units to be capable of monitoring two independent voltage free contacts, each either normally open or normally closed, using a single loop address.
- B The unit is to be
 - 1 powered directly from the addressable loop.
 - 2 Complete with a red LED indication when the FAP is polling it.
 - 3 Continuously lit when either input is active

W50.2.22 MANUAL CALL POINTS

- A Manual call points (previously called break glass units) operate on a loop of intelligent fire detection devices and when activated interrupt the polling cycle for a very fast response. The manual call points to be operated by thumb pressure (not requiring a hammer). Provide a transparent hinged cover for all units to give protection against accidental operation.
- B The units to red in colour and suitable for surface or flush mounting depending upon location. External units to be rated IP66
- C Provide a single bi-coloured alarm LED on the call point. This LED is controlled independently of the call point by the FAP. The LED is illuminated red when the call point has been activated. The LED is illuminated amber/yellow to indicate a short circuit.
- D Once activated, MCP can be reset by inserting the test key into the bottom of the unit until the key clicks into position. The test key is then removed, and the front cover is pushed up until it clicks into position
- E Manual Call Point technical details:
 - 1 Supply voltage 17 V - 28 V dc
 - 2 Digital communication: Open Protocol compatible with FAP
 - 3 Communication protocol: 5 - 9 V peak to peak
 - a Maximum current consumption at 24 V
 - b Quiescent current 100 μ A
 - 4 Power-up surge 1 second typical
 - 5 Alarm LED on: 4 mA
 - 6 Operating temperature (ambient): -20°C to 60°C
 - 7 IP rating:
 - a Internal: IP45
 - b External IP66
 - 8 Standards and Approvals: BS EN 54-11, EN 54-17 (isolated version), IEC 61508-1, 2, LPCB
 - 9 Dimensions 93 mm x 89 mm x 59.5 mm
 - 10 Body: red polycarbonate
- F Unit to incorporate a short circuit isolator which ensures operation in the event of a short circuit fault on the loop

W50.2.23 ASPIRATING DETECTION DEVICES

- A Provide Aspirating smoke detectors where required and as indicated on the drawings
- B Operation: Air is drawn from the protected area by a fan through a number of perforated pipes per channel. The air is filtered and processed by a centralised detection unit. If smoke is detected the fire alarm is triggered. Optical smoke detectors are incorporated to perform the sampling.
- C Technical details
 - 1 Optical Detectors: 1 per channel inlet analogue addressable type prewired to detector bases

- 2 Inlets channels: 2
 - 3 Sampling pipes
 - a Max length: 50m
 - b Diameter: 25mm
 - 4 Exhaust pipe: 25mm
 - 5 Supply voltage: 24VDC
 - 6 Supply voltage detector: 17-28V loop powered
 - 7 Max Alarm loop current: 10.6mA
 - 8 Operating current: 300mA from external power supply unit
 - 9 Fault monitoring:
 - a Power failure external
 - b Flow fault per channel
 - 10 Relay outputs: 2 changeover relays (fault monitoring)
 - 11 Display: 5 common status + 10 segment LED bar graph per channel
 - 12 Flow monitoring: thermal type
 - 13 Filtration: dust/harsh environment particle filter
 - 14 IP rating: IP 65
 - 15 Housing: ABS with tamper proof locking mechanism and key
 - 16 Approvals: CE, LPCB
 - 17 Standards and test certification:
 - a BS 5839
 - b BS 6266
 - c BFPSA Code of Practice for category 1 Aspirating Detection Systems
- D The aspirating smoke detection system shall be supplied, installed and commissioned by the specialist contractor in accordance with the requirements detailed in the BFPSA Code of Practice for Category 1 Aspirating Detection Systems.
- E Adjust the system sensitivity to provide detection sensitivity as follows:
- 1 Normal Sensitivity: as normal point detectors - typically 3% - 5% obscuration per metre
 - 2 Enhanced Sensitivity: responding to smoke at concentrations of between 2% and 0.8% obscuration per metre
 - 3 High Sensitivity: responding to smoke at concentrations of less than 0.8% obscuration per metre.
- F Install the sampling pipe system and identify in accordance with the British Fire Protection Systems (BFPSA) code of practice for category 1 Aspirating Detection Systems and marked 'Aspirating smoke detection system pipe - do not paint or obstruct sampling holes'. Clearly mark all sampling point holes.
- G Provide evidence of flow/pressure calculations for the 'as installed' system to ensure optimum sampling performance.

W50.2.24 ELECTROMAGNETIC DOOR HOLDERS

- A Description: Units are equipped for wall or floor mounting as indicated and are to be complete with matching doorplate. The door holder is fitted with a spring-loaded release pin mounted centrally within the electromagnet. On power off, the release pin pushes the door away from the electromagnet. The units to incorporate a manual release mechanism allowing the door to be closed without activating the fire alarm system.
- B Door holders to be wall or floor mounted type and conform to the following:
- 1 Standards:
 - a BS EN 1155
 - b BS EN 1634-2
 - c CE marked
 - 2 Electromagnet: ≤ 3 W to develop 111-N holding force

- 3 Rating: 24Vdc
- 4 Max Current Consumption: 45mA
- 5 Max holding force: 200N
- 6 Wall-Mounted Units: Flush mounted unless otherwise indicated
- C Operation: The door release is achieved by an interface unit on the loop which provides an output to the door release device when there is a fire alarm. Provide a fail-safe operation when the output is operated to release doors when the interface loses connection or communication with the fire alarm system after a pre-determined time period. The fail-safe can be used for all types of other output applications.
- D Material and Finish: Match door hardware and seek approval for finish.
- E Refer to paragraphs below for specification of the addressable door control module.

W50.2.25 DOOR RELEASE / MAINS POWERED INTERFACE

- A Mains powered interfaces are required where ancillary equipment cannot be directly connected to the fire alarm loop Typical applications:
 - 1 Door release mechanisms
 - a Standard: BS7273
 - b Category A
 - 2 Intrinsically safe devices
 - a IS detection zones and alarm circuits
- B Technical details:
 - 1 Type: Interface
 - 2 Standards:
 - a Certified BS EN54: Part 4, BS EN54:Part 17,BS EN54:Part 18
 - 3 Maximum Number:100 Units Per Loop
 - 4 Enclosure: Steel
 - 5 Ingress Protection: IP31
 - 6 Operating Voltage: 230v 50hz +10% -6%
 - 7 Current Consumption: 0.7A
 - 8 Input Modes:
 - a Fault Monitored,
 - b Voltage Free Contacts
 - c Conventional Detection
 - 9 Quiescent Current 20mA Per Zone
 - 10 Output Modes:
 - a Monitored 24V (Nominal) 0.5A
 - b LED Drive.
 - 11 Maximum Total Output Current:1.5A
 - 12 Auxiliary Power Output: 24v +/- 3v
 - 13 Batteries: 2 x 12V 12Ahr

W50.2.26 CONVENTIONAL DETECTOR INTERFACE MODULES

- A Provide conventional detector interface modules where connecting to existing conventional detector and alarm systems. The module to be capable of monitoring two independent zones, each of up to 30 conventional detectors using a single loop address.
- B 24 V DC power to power the conventional detectors to be derived independently from the FAP.

Provide the facility to monitor the detector zones for open or short-circuit and transmit the necessary fault signal to the FAP.

- C Provide a remote LED facility to indicate detectors in alarm and a red LED indication when the FAP is polling it.

W50.3 PART 3 – EXECUTION

W50.3.1 EQUIPMENT INSTALLATION

- A Install the FDAS system in accordance with the following and manufacturer's instructions:
- 1 BS 5839-1 (Fire detection and fire alarm systems for buildings - Code of practice for system design, installation, commissioning and maintenance)
 - 2 BS 7671 (Requirements for Electrical Installations - IET Wiring Regulations,)
- B The FDAS is responsible for the correct siting of all equipment and components of the system in accordance with approved installation drawings and manufacturer's installation instructions.
- C Wiring: Fully test all cabling and wiring **before** connection to the fire controller and its associated devices. Devices will be damaged if testing is carried out after connection.
- D For detectors fitted to a false ceiling provide a suitable adaptor to allow the assembly and installation of the detector and base to be completed and tested prior to the installation of the ceiling tile.
- E Cable and wire entries to detector bases: Provide
- 1 Grommets to prevent possible damage to the insulation.
 - 2 Cable and wire strain relief clamps entries to detector bases.
 - 3 Seals for use in environments with abnormal atmospheric or operating conditions to prevent ingress of dust, water, moisture or other such contaminants. Use suitably I.P. rated back boxes, in such environments

W50.3.2 IDENTIFICATION

- A Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in V80 Electrical Identification.

W50.3.3 TESTING AND COMMISSIONING

- A The complete FDAS is to be commissioned by a competent person employed by the FDAS specialist installing company in accordance with BS 5839-1. The purposes is to
- 1 Verify correct operation of the system
 - 2 Check that workmanship is of an adequate standard.
 - 3 Check that adequate sound pressure levels are achieved
 - 4 All monitoring and reporting of detector status is correct
- B Carry out site testing and inspection and provide test certificates for fire protection of electronic data processing installations in accordance with BS 6266.
- C Installation testing: Carry out the following tests and checks for the complete installation and rectify any defects or faults discovered.
- 1 Continuity check
 - 2 Polarity check
 - 3 Equipment terminations
 - 4 Loop integrity: power and data cables
 - 5 Diagnose and rectify any faults
- D Function tests: The entire system should be inspected and tested to ensure that it operates satisfactorily and that, in particular:
- 1 all manual call points and automatic fire detectors function correctly
 - 2 all labelling and identification of devices is complete and registers correctly at the central controls

- 3 every manual call point and automatic fire detector, on operation, results in the correct zone indication, and text displays
 - 4 optical beam detectors transmitters and receivers are correctly adjusted
- E Acoustic test: Ensure that the sounders provide the following sound pressure levels:
- 1 Sound pressure levels to be:
 - a In all accessible areas of building: $\geq 65\text{dBA}$
 - b In stairways: $\geq 60\text{dBA}$
 - c Enclosures not more than 60m^2 : $\geq 60\text{dBA}$ (eg cellular offices)
 - d Specific and limited number of points: $\geq 60\text{dBA}$
 - e Not less than 75 dB(A) at the bedhead within rooms in which the FDAS is intended to rouse people from sleep;
 - f Maximum level at any normally accessible location: 120dBA
 - 2 Sound pressure levels in areas of high ambient noise ($\geq 60\text{dBA}$) the sound pressure level of the fire alarm signal should be 5 dBA above the sound pressure level of the background noise.
 - a Note:
 - Background noise that is unlikely to persist for longer than 30 s may be ignored.
 - This does not apply to noise created by running water in bathrooms and shower rooms.
 In areas with background or live music/speech $\geq 80\text{dBA}$ provide automatic muting of the amplified music/speech
 - 3 Ensure that visual alarms are provided where the ambient noise levels are in excess of 90 dBA .
- F Witnessing: All tests are to be witnessed and signed off by the Commissioning Management Specialist. Provide appropriate test sheets for this purpose. Testing to include:
- 1 insulation and continuity tests to cover all circuits, prior to installation of devices
 - 2 visual inspection of the whole of the installation.
functional operation of all panels, devices, accessories and items of equipment including such items as may have been supplied by others but wired under the electrical installation. These tests to be made under:
 - a normal operating conditions
 - b 24 hour simulated mains failure followed by 1-hour sounder duration check
 - c 20No. simulated faults, at randomly chosen locations on each loop circuit and sounder interface secondary circuit for each of following type: -
 - Open circuit.
 - Short circuit.
 - Sensor removal/alarm device removal.
 - Earth fault.
 - 3 Prove function of override facilities installed to inhibit operation of any shut down systems during routine fire alarm system testing.
 - 4 Prove that all interfaces with other systems are functioning correctly
- G Provide current certificates of calibration for all instruments used during test procedures. Record particular instrument identity on record sheets.

W50.3.4 CAUSE AND EFFECT STRATEGY DEMONSTRATION

- A FDAS is responsible for preparing the detailed Cause and Effect Strategy in a matrix format showing the interrelationship between the Fire Alarm activation inputs and the effect of the activation on various installations.
- B Demonstrate, to the CA and the Commissioning Management Specialist, with the assistance of the trade contractors and specialist equipment suppliers that all inputs and outputs operate correctly and that the appropriate responses are achieved by each of the systems/interfaces.

W50.3.5 CLIENT TRAINING AND DEMONSTATION

- A Engage a factory-authorized service representative to train the Employer's maintenance personnel to adjust, operate, and maintain the FDAS systems and equipment. Liaise with the Commissioning Management Specialist and agree the content and programming of the training scheme.
- B Operate the fire alarm system for a period of 2 weeks prior to handover during which the following tests are to be carried out with the assistance of the FDAS
 - 1 Test 1- Equipment test
 - a Place all installed equipment under test for at least one week following final commissioning of the system, to verify the satisfactory and acceptable operation of the system / equipment.
 - 2 Test 2 Functional test
 - a The employer to test for a minimum of 1 week, the functional operation of all systems following the satisfactory completion of test 1.
 - b In the case of any equipment or system operation failure, the failed equipment must be replaced, or the failed system operation rectified.

W50.3.6 FIRE EXTINGUISHING INSTALLATIONS AND EQUIPMENT ON PREMISES

- A Carry out site testing and inspection and provide test certificates for fire extinguishing installations and equipment on premises in accordance with BS 5306 and the following specification sections:
 - 1 Fire protection systems: Refer to the following
 - a Automatic Sprinklers: S63
 - b Wet risers: S62
 - c Deluge systems: S64
 - d Water Mist Systems: S66
 - e Gaseous extinguishing systems: S70
 - f Foam fire- fighting systems: S76

W50.3.7 DOCUMENTATION & LOGBOOK

- A Provide the following documentation at practical completion:
 - 1 Certificates for design, installation and commissioning of the system
 - 2 Operation and maintenance manual for the system;
 - 3 As-fitted drawings indicating but not limited to the following:
 - a Positions of all control, indicating and power supply equipment;
 - b Positions of all detectors, call points, emergency telephones, and control panels.
 - c Positions of all equipment that may require routine attention or replacement (e.g. detectors, disabled call systems);
 - d Type, sizes and actual routes of cables;
 - 4 A logbook for recording the all events that occur in respect of the system, including fire signals, fault signals and work on the system. The logbook for the voice alarm system may be combined with the fire detection and fire alarm system logbook. The following information should be recorded in the logbook:
 - a the name of the responsible person;
 - b any emergency broadcast not initialized by the fire detection and fire alarm system or manually from the VACIE;
 - c details of the maintenance organization;
 - d brief details of maintenance arrangements;
 - e dates, times and types of all tests;
 - f dates, times and types of all faults, disablements and defects;
 - g dates and types of all maintenance (e.g. maintenance visit or non-routine attention).
 - h Where the voice alarm system logbook is combined with the fire detection and fire alarm system logbook, this should be clearly indicated in the combined logbook.

- i Record of any agreed variations from the original design specification;

B Provide the following documents at handover:

- 1 **Record drawings:** Based on the installation drawings but amended to show the final installation
- 2 **Fire Alarm cause and effect Strategy:** and final version
- 3 **Testing and commissioning records:** Record the results of all testing and commissioning on approved record sheets. Testing and commissioning to be witnessed by the Commissioning Management Specialist.
- 4 **Final Completion Certificates**
- 5 **Sound level measurements:** for all areas demonstrating compliance with the requirements
- 6 **Operation and Maintenance Data:** For systems and components to include in the operation and maintenance manuals by the Technical Documentation Specialist employed by the commissioning management specialist. Refer to Y50
- 7 **Handover Information** as requested by the Technical Documentation specialist for incorporation into the following documents:
 - a Operators Logbook
 - b Building Manual
 - c Building User Guide
 - d Operation and Maintenance Manuals for the Fire Alarm system incorporating any agreed variations from the original design specification. Include Asset Register
 - e Record drawings

W52 ASSISTANCE CALL SYSTEMS

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W52.1 PART 1 – GENERAL

W52.1.1 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 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 Low Voltage Connection – V11
 - 2 Low Voltage Distribution – V30
 - 3 Low Voltage Switchgear – V31
 - 4 Electrical Identification – V80
 - 5 Earthing and Bonding Systems – V81
 - 6 Y41 Building Monitoring and Management
 - 7 Y50 Electrical Commissioning
 - 8 Y60 Conduit and Trunking
 - 9 Y61 LV and ELV Cables
 - 10 Y63 Cable Supports
 - 11 Y90 Fixing to Building

W52.1.2 SUMMARY

- A Assistance Call System refers to the following systems:
 - 1 Disabled Toilet Alarms
- B The Assistance Call System Specialist shall provide all necessary components to form a complete system (or systems) for the project.
- C Work includes providing all materials, equipment, accessories, services and tests necessary to complete and make the system(s) ready for operation by the Owner, in accordance with Drawings and Specifications.
- D The system components are located on the Fire Alarm System layout drawings and the system schematic drawing.
- E The system(s) shall include, but not be limited to, the following items:
 - 1 Remote Stations (Disabled WC Alarm)
 - 2 Non fire rated system cabling (Disabled WC Alarms)
 - 3 24 hour battery back-up provision
 - 4 System connection units for Disabled WC Alarm systems
 - 5 Main Panel and remote station back boxes and enclosures.

W52.1.3 DEFINITIONS

- A Pigtail: Short lead used to connect a device to a branch-circuit conductor
- B LEDC: Local Electrical Distribution Company
- C RSB: Regulation and Supervision Bureau
- D RCD: Residual Current Device
- E IP: Index of Protection

F	BC: Bayonet Connection
G	ES: Edison Screw
H	DP: Double Pole
I	TPN: Three Phase and Neutral
J	2PE: 2 phase and Earth
K	CPC: Circuit Protective Conductor.

W52.1.4 SUBMITTALS

- A Complete a detailed original data sheet & catalogue for all of the proposed system equipment.
- B List all types of equipment and components provided as part of the system, including model numbers, mounting accessories and quantities.
- C Provide a detailed description of operation of the system, including all exceptions, variances or substitutions listed at the time of bid.
- D Provide samples of all the field devices
- E Shop drawings: Provide 1:50 scale floor plan showing equipment locations, drawings and containment and conduit runs.
- F Provide a detailed single line diagram indicating all the system(s) components, cables and interfaces to other systems and trades.
- G Compliance List: submit a detailed point by point compliance statement with this specification. Where the proposed system does not comply or accomplish the stated function or specification in a manner different from that described and specified, a full description of the deviation shall be provided.

Where a full description is not provided it shall be assumed that the proposed system does not comply with the requirements in the specification.
- H General Submittal Requirements:
 - 1 Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect
 - 2 Shop Drawings shall be prepared by persons with the following qualifications:
 - a Trained and certified by manufacturer in emergency communications system design
- I Qualification Data: For qualified Installer.
- J Field quality-control reports.
- K Operation and Maintenance Data: For systems and components to include in operation and maintenance manuals. In addition to items specified in the Operation and Maintenance Data include the following:
 - 1 Record copy of site-specific software
 - 2 Provide Maintenance, Inspection and Testing Records and include the following:
 - a Frequency of testing of installed components
 - b Frequency of inspection of installed components
 - c Requirements and recommendations related to results of maintenance.
 - d Manufacturer's user training manuals
 - 3 Manufacturer's required maintenance related to system warranty requirements
 - 4 Abbreviated operating instructions for mounting at system control panels.

W52.1.5 QUALITY ASSURANCE

- A Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

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- B Installer Qualifications: Installation shall be by personnel certified to operate as a fire alarm system installer in region.
- C Source Limitations for System and Components: Obtain emergency communications system from single source from single manufacturer.
- D Electrical Components, Devices, and Accessories: Listed and labelled as defined in IET Wiring Regulations, by a qualified testing agency, and marked for intended location and application.
- E Ensure that the whole installation complies with the relevant standards, including the following:
 - 1 BS7671 +A2 - Requirements for electrical installations. IEE Wiring Regulations. Seventeenth edition
 - 2 BS 8300+A1- Design of buildings and their approaches to meet the needs of disabled people. Code of practice
 - 3 BS 9999 - Code of practice for fire safety in the design, management and use of buildings.

W52.1.6 SOFTWARE SERVICE AGREEMENT

- A Technical Support: Beginning with Substantial Completion, provide software support for two years.
- B Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software:
 - 1 Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

W52.1.7 EXTRA MATERIALS

- A Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1 Lamps for Indicating Lamp Units: Quantity equal to 10 percent of amount installed
 - 2 Keys and Tools: One extra set for access to locked and tamper proofed components
 - 3 Fuses: Five of each type installed in the system.

W52.2 PART 2 – PRODUCTS

W52.2.1 MANUFACTURERS

- A Manufacturers: Subject to compliance with requirements, provide products and complete system (or systems) by one of the following:
- 1 Baldwin Boxall Communications Ltd
 - 2 Cooper Fire and Security
 - 3 Protec
 - 4 Other Equal Approved.

W52.2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A A monitored, combined Emergency Communications system (or systems) comprising Disabled Toilet alarm calls shall be provided as indicated on the Fire Alarm layout drawings and system schematic.
- B All system components shall be UL and/or CE listed and clearly marked as such by the manufacturer.

W52.3 PART 3 – EXECUTION

W52.3.1 EQUIPMENT INSTALLATION

- A Install Disabled Toilet system devices, wiring and main equipment as indicated, in accordance with manufacturer's written instructions, requirements of applicable Standards, and in accordance with recognized industry practices to ensure that the installation(s) complies with requirements and provides the intended function.

W52.3.2 IDENTIFICATION

- A Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in V80 Electrical Identification.
- B Install framed instructions in a location visible from fire-alarm control unit.

W52.3.3 FIELD QUALITY CONTROL

- A Field tests shall be witnessed by a Client's representative and/or Building Control/Fire Officer.
- B Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C 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.
- D Tests and Inspections:
 - 1 Visual Inspection: Conduct visual inspection prior to testing. Inspection shall be based on completed Record Drawings and system documentation that is required elsewhere within this specification
- E Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- F Prepare test and inspection reports.

W52.3.4 DEMONSTRATION

- A The Fire Alarm Contractor shall provide a factory-authorized service representative to train the owner's maintenance personnel to adjust, operate, and maintain the Fire Telephone, Disabled Refuge and Disabled Toilet Alarm system (or systems).

Y10 PIPELINES

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Y10.1 PART 1 – GENERAL

Y10.1.1 RELATED DOCUMENTS

A For drawings and general provisions of the contract refer to main contract preliminaries.

B Related sections include the following:

1	Pipework Valves and accessories	Y11
2	Mechanical Cleaning and Chemical treatment	Y12
3	Thermal Insulation	Y30
4	Vibration isolation Mountings	Y31
5	Mechanical Plant and equipment identification	Y32
6	Building monitoring and management systems	Y41
7	Testing and commissioning.	Y50
8	Fixing to building Fabric	Y90.

Y10.1.2 SUMMARY

A This section includes pipe and fitting materials, joining methods and installation criteria for the pipework services. Use only the materials stated in this section. Refer to the schedule in section B for exact material pressure ratings and specification clauses to be use. Refer also to section B for the selection of any optional materials for the particular project applications and working pressures and temperatures.

1	Potable water, hot and cold-water services: all applications:	Copper, stainless steel

B This section includes pipework supports and facilities to accommodate pipework movement and thermal expansion.

Y10.1.3 DEFINITIONS

A The following acronyms are used in this specification

- 1 EPDM: Ethylene Propylene Diene Monomer
- 2 NPS: Nominal Pipe Size (inch)
- 3 NB: Nominal Bore
- 4 OD: Outside Diameter
- 5 LTHW: Low Temperature Hot Water (<100°C)
- 6 MTHW: Medium Temperature Hot Water (100 to 149°C)
- 7 HTHW: High Temperature Hot Water (>150°C but < 232°C)
- 8 BMS: Building management system
- 9 PED: Pressure Equipment Directive.
- 10 MDPE: Medium Density Polyethylene
- 11 HDPE: High Density Polyethylene
- 12 HPPE: High Performance Polyethylene
- 13 GPS: Global Positioning System.
- 14 IPS: Iron Pipe Size.

Y10.1.4 PERFORMANCE REQUIREMENTS

A For system operating pressures and temperatures refer to documents

Y10.1.5 DELEGATED DESIGN

A Provide design calculations and details for all pipework and equipment support systems.

B Design the pipeline support system to take into account the following:

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- 1 Size of the pipelines and fittings
 - 2 Contents
 - 3 Materials of construction
 - 4 Thermal and acoustic insulation
 - 5 Vibration isolation components
 - 6 Amount and direction of movement
 - 7 Location of the pipeline in relation to the building fabric and other services
 - 8 Access requirements
 - 9 Selected equipment and manufacturer's requirements.
- C Provide the design calculations, selection and installation of all items necessary to control the thermal expansion of pipework including:
- 1 Anchors and guides
 - 2 Expansion loops or mechanical expansion joints.
 - 3 Assessments of expected building structural movements (seek advice from CA)
 - 4 Provide calculations based on the installation drawings and final selection of plant and equipment.

Y10.1.6 SUBMITTALS

- A Provide samples of pipework for each service with manufacturer's certification that the sample is suitable for the working and test conditions specified.
- B For fabricated joints provide a sample demonstrating quality that will be achieved.
- C Expansion provisions delegated design submittal: For each expansion joint, anchor and alignment guide: provide:
- 1 Design criteria, thermal expansion calculations, swing type connections, safety factor allowances and type of expansion joints selected
 - 2 Details of forces exerted on the pipework system that are to be restrained by the anchors:
 - a Main Anchor: Pipe anchors are required to control pipe expansion or contraction. Main anchors must withstand the full bellows thrust due to pressure, flow and spring forces.
 - b Intermediate anchor: Must withstand the bellows thrust due to flow, spring forces but not pressure.
 - 3 Calculations: For thermal expansion of piping systems.
 - a Standard pipework: Calculations to be prepared and signed by a qualified professional engineer responsible for their preparation who is also responsible for checking that the installation complies with the calculated expansion arrangements
 - b Victaulic pipework: Calculations to be prepared and signed by the manufacturer who is responsible for their preparation who is also responsible for checking that the on-site installation complies with the calculated expansion arrangements
 - c Plastic pipework: Calculations to be prepared and signed by the manufacturer who is responsible for their preparation who is also responsible for checking that the on-site installation complies with the calculated expansion arrangements
 - 4 Anchor Details: Fabrication details of each anchor required. Indicate dimensions and methods of assembly and attachment to building structure and locations with respect to expansion joints and building movement joints.
 - 5 Alignment guide details: Field assembly, correct positioning and attachment to building structure.
 - 6 Expansion Joints Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
 - 7 Approval from structural engineer to method of attachment to the building structure and confirmation that imposed loads are acceptable.
- D Pipework support delegated design: Provide calculation details for each type of support and method of attachment to the building structure:
- E Product data for each type of solvent, adhesive or primers to be used.

- F Installation drawings: Detail, at 1:50 scale, the piping layout, fabrication of pipe anchors, hangers, supports for single and multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
- G Co-ordinated working drawings: Working plans and sections that demonstrate co-ordination with other mechanical electrical and plumbing services.
- H Certificates for operatives involved.
 - a Welding certificates
 - b Press-fit certification if this type of jointing is permitted (refer to section B).
- I Field test reports and Certificates: Indicate and interpret test results for compliance with performance requirements. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- J Field quality-control reports for the following showing satisfactory completion. All testing to be witnessed and signed off by the project Commissioning Specialist.
 - 1 Pipework pressure testing
 - 2 Pipework cleaning and flushing
 - 3 Closed systems water treatment
 - 4 Open systems water treatment
 - 5 Inspection of joints for press-fit installation.
- K Operation and maintenance data: Provide for all pipework systems, pipework supports, water tanks, pumps, sprinkler pumps and accessories.

Y10.1.7 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 will be exposed.
- B Ensure that the whole pipework installation complies with the relevant standards, including the following:
 - 1 BS 10 - Specification for flanges and bolting for pipes, valves, and fittings
 - 2 BS EN 10226-1 Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation
 - 3 BS 143 and 1256 (BS EN 10242) - Threaded pipe fittings in malleable cast iron and cast copper alloy
 - 4 BS 2633 Specification for class 1 arc welding of ferritic steel pipework for carrying fluids
 - 5 BS 2879 - Specification for draining taps (screw-down pattern)
 - 6 BS 2971 - Specification for class II arc welding of carbon steel pipework for carrying fluids
 - 7 BS 3643 - ISO metric screw threads. Principles and basic data
 - 8 BS 4190 - ISO metric black hexagon bolts, screws and nuts. Specification
 - 9 BS 4921 - Specification for sherardized coatings on iron and steel
 - 10 BS 4991: Specification for propylene copolymer pressure pipe
 - 11 BS 6129-1: Code of practice for the selection and application of bellows expansion joints for use in pressure systems. Metallic bellows expansion joints
 - 12 BS 6920-2.1: Suitability of non-metallic materials and products for use in contact with water intended for human consumption with regard to their effect on the quality of the water. Methods of test. Samples for testing
 - 13 BS 6956 Parts 1, 5, 6 and 7 Jointing materials and compounds
 - 14 BS 5391-1 - Acrylonitrile-butadiene-styrene (ABS) pressure pipe. Specification
 - 15 BS 5392-1 - Acrylonitrile-butadiene-styrene (ABS) fittings for use with ABS pressure pipe. Specification
 - 16 BS 6956-1 - Jointing materials and compounds. Specification for corrugated metal joint rings
 - 17 BS 6956-5 - Jointing materials and compounds. Specification for jointing compounds for use with water, low pressure saturated steam, 1st family gases (excluding coal gas) and 2nd family gases
 - 18 BS 7291-3: Thermoplastics pipe and fitting systems for hot and cold water for domestic purposes and heating installations in buildings. Specification for crosslinked polyethylene (PE-X) pipes and associated fittings
 - 19 BS 7671: +A3: Requirements for Electrical Installations. IET Wiring Regulations

- 20 BS 7786 - Specification for unsintered PTFE tapes for general use
- 21 BS 8313: Code of practice for accommodation of building services in ducts
- 22 BS 8537 - Copper and copper alloys. Plumbing fittings. Specification for press ends of plumbing fittings for use with metallic tubes
- 23 BS 8558: Guide to the design installation, testing and maintenance of services supplying water for domestic use within building and their curtilages – Complementary guidance to BS EN 806
- 24 BS EN 197-1: Cement. Composition, specifications and conformity criteria for common cements
- 25 BS EN 253: +A2: District heating pipes. Preinsulated bonded pipe systems for directly buried hot water networks. Pipe assembly of steel service pipe, polyurethane thermal insulation and outer casing of polyethylene
- 26 BS EN 448: District heating pipes. Preinsulated bonded pipe systems for directly buried hot water networks. Fitting assemblies of steel service pipes, polyurethane thermal insulation and outer casing of polyethylene
- 27 BS EN 489: District heating pipes. Pre-insulated bonded pipe systems for directly buried hot water networks. Joint assembly for steel service pipes, polyurethane thermal insulation and outer casing of polyethylene
- 28 BS EN 545: Ductile iron pipes, fittings, accessories and their joints for water pipelines. Requirements and test methods
- 29 BS EN 682 - Elastomeric seals. Materials requirements for seals used in pipes and fittings carrying gas and hydrocarbon fluids
- 30 BS EN 806-1 to 5: Specifications for installations inside buildings conveying water for human consumption
- 31 BS EN 877: +A1: Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings. Requirements, test methods and quality assurance
- 32 BS EN 1057+A1 - Copper and copper alloys - seamless, round copper tubes for water and gas in sanitary and heating applications
- 33 BS EN 1092-1 - Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel flanges
- 34 BS EN 1092-2 - Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Cast iron flanges
- 35 BS EN 1092-3 - Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Cop
- 36 per alloy flanges
- 37 BS EN 1092-4 - Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Aluminium alloy flanges
- 38 BS EN 1011-3: Welding. Recommendations for welding of metallic materials. Arc welding of stainless steels
- 39 BS EN 1254-1 - Copper and copper alloys. Plumbing fittings. Fittings with ends for capillary soldering or capillary brazing to copper tubes
- 40 BS EN 1254-2 - Copper and copper alloys. Plumbing fittings. Fittings with compression ends for use with copper tubes
- 41 BS EN 1329-1: Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Unplasticized poly (vinyl chloride) (PVC-U). Specifications for pipes, fittings and the system
- 42 BS EN 1412: Copper and copper alloys. European numbering system
- 43 BS EN 1451-1: Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Polypropylene (PP). Specifications for pipes, fittings and the system
- 44 BS EN 1563 – Founding. Spheroidal graphite cast iron
- 45 BS EN 10088-2: Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes
- 46 BS EN 10216-1 - Seamless steel tubes for pressure purposes. Technical delivery conditions.
- 47 BS EN 10216-5 - Seamless steel tubes for pressure purposes. Technical delivery conditions. Stainless steel tubes
- 48 BS EN 10217-1 - Welded steel tubes for pressure purposes. Technical delivery conditions. Non-alloy steel tubes with specified room temperature properties

- 49 BS EN 10217-7 - Welded steel tubes for pressure purposes. Technical delivery conditions. Stainless steel tubes
- 50 BS EN 10241 - Steel threaded pipe fittings
- 51 BS EN 10253-1 - Butt welding pipe fittings. Wrought carbon steel for general use and without specific inspection requirements
- 52 BS EN 10255 - Non-alloy steel tubes suitable for welding and threading. Technical delivery conditions
- 53 BS EN 10266: Steel tubes, fittings and structural hollow sections. Symbols and definitions of terms for use in product standards
- 54 BS EN 10296-2: Welded circular steel tubes for mechanical and general engineering purposes. Technical delivery conditions. Stainless steel
- 55 BS EN 10297-2: Seamless circular steel tubes for mechanical and general engineering purposes. Technical delivery conditions. Stainless steel
- 56 BS EN 10312 - Welded stainless-steel tubes for conveyance of aqueous liquids including water for human consumption. Technical delivery conditions
- 57 BS EN 12201-2 - Plastic piping systems for water supply and for drainage and sewerage under pressure. Polyethylene (PE). Pipes
- 58 BS EN 12201-3 - Plastic piping systems for water supply, and for drainage and sewerage under pressure. Polyethylene (PE). Fittings
- 59 BS EN 12201-5 - Plastic piping systems for water supply, and for drainage and sewerage under pressure. Polyethylene (PE). Fitness for purpose of the system
- 60 BS EN 12449: Copper and copper alloys. Seamless, round tubes for general purposes
- 61 BS EN 12451 - Copper and copper alloys. Seamless, round tubes for heat exchangers
- 62 BS EN 12536: Welding consumables. Rods for gas welding of non-alloy and creep-resisting steels. Classification
- 63 BS EN 12845 +A2 - Fixed firefighting systems. Automatic sprinkler systems. Design, installation and maintenance
- 64 BS EN 13349: Copper and copper alloys. Pre-insulated copper tubes with solid covering
- 65 BS EN 13480 (all parts): Metallic industrial piping.
- 66 BS EN 13941: +A1: Design and installation of preinsulated bonded pipe systems for district heating
- 67 BS EN 14324 - Brazing. Guidance on the application of brazed joints
- 68 BS EN 14814: Adhesives for thermoplastic piping systems for fluids under pressure. Specifications
- 69 BS EN 14901: Ductile iron pipes, fittings and accessories. Epoxy coating (heavy duty) of ductile iron fittings and accessories. Requirements and test methods
- 70 BS EN ISO 1452-2 - Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Un-plasticized poly (vinyl chloride) (PVC U). Pipes
- 71 BS EN ISO 1452-3 - Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly (vinyl chloride) (PVC U). Fittings
- 72 BS EN ISO 12162: Thermoplastics materials for pipes and fittings for pressure applications. Classification, designation and design coefficient
- 73 BS EN ISO 13585: Brazing. Qualification test of brazers and brazing operators
- 74 BS EN ISO 15493:2003+A1: Plastics piping systems for industrial applications. Acrylonitrile-butadiene-styrene (ABS), unplasticized poly(vinyl chloride)(PVC-U) and chlorinated poly(vinyl chloride) (PVC-C). Specifications for components and the system. Metric series
- 75 BS EN ISO 15494:Plastics piping systems for industrial applications. Polybutene (PB), polyethylene (PE), polyethylene of raised temperature resistance (PE-RT), crosslinked polyethylene (PE-X), polypropylene (PP). Metric series for specifications for components and the sy
- 76 BS EN ISO 15874-2:Plastics piping systems for hot and cold water installations. Polypropylene (PP). Pipes
- 77 BS EN ISO 17672 - Brazing. Filler metals
- 78 BS ISO 4437 (all parts) - Plastics piping systems for the supply of gaseous fuels. Polyethylene (PE). Specifications
- 79 GIS/PL2 - Gas Industry Standard - Technical polyethylene pipes and fittings for natural gas and suitable manufactured gas
- 80 WIS 4-32-08 - Water Industry Specifications - Fusion jointing of polyethylene pressure pipeline systems using PE80 and PE100 materials
- 81 WIS 4-32-19 - Water Industry Specifications - Polyethylene pressure pipe systems with an aluminium barrier layer for potable water supply and sewerage duties

82 Expansion Joint Manufacturer's Association.

C Painting and Coating Quality assurance:

- 1 Ensure that the whole installation complies with the relevant standards, including the following:
 - a BS 388 - Specification for aluminium pigments
 - b BS 1070 - Specification for black paint (tar-based)
 - c BS 3416 - Specification for bitumen-based coatings for cold application, suitable for use in contact with potable water
 - d BS 3698 - Specification for calcium plumbate priming paints
 - e BS 4652 - Specification for zinc-rich priming paint (organic media)
 - f BS 6150 - Code of practice for painting of buildings
 - g BS 6949 - Specification for bitumen-based coatings for cold application excluding use in contact with potable water
 - h BS 7956 - Specification for primers for woodwork
 - i BS EN ISO 4618 - Paints and varnishes. Terms and definitions for coating materials
 - j BS EN ISO 8503 - Preparation of steel substrates before application of paints and related products. Surface roughness characteristics of blast-cleaned steel substrates.

Y10.1.8 CO-ORDINATION

- A Co-ordinate layout and installation of pipework with other services, HVAC equipment, and architectural elements and partition assemblies.

Y10.2 PART 2 – PRODUCTS

Y10.2.1 GENERAL

- A Alternative pipework selections: Consideration may be given to the use of proprietary manufactured products as an alternative to the pipework indicated in this specification. Provide full product details together with quality standards and certification and seek approval for the use of any alternative materials.
- B Refer to "Schedule of Pipework" in section B of this specification for the materials selection of pipework and operating conditions for each service.
- C Grooved ended couplings may be considered provided the joints are suitable for the ranges of pressures and temperatures indicated and the service being carried. They must not be used for services operating in excess of 99°C. In addition, a detailed expansion and anchor analysis will be required to be provided as the inherent flexibility of these types of joints behaves in a different manner from standard pipework.
- D The sizes indicated in this section are those used in normal convention and indicated on the drawings:
- 1 Steel Pipes: Nominal Bore
 - 2 Copper Pipes: Outside diameter
 - 3 Plastic pipework: Outside Diameter.
- E Refer to clause Y10.3.24 of this specification section for details of pipework painting which applies to all insulated and uninsulated ferrous pipework/supports and any uninsulated exposed services.
- F Fuel oil: Where fuel oil is distributed throughout the building route within a double pipe construction where the outer pipe is the containment for leakage or tank overflows.
- 1 Inner pipework: All welded construction.
 - 2 Outer pipework: To the same pressure rating as the internal bore pipework.
- G For restrictions on routing of gas pipework refer to part 3 of this section.
- H All pipework, fittings, products and materials used in domestic water services installations must comply with the Water Regulations Advisory Scheme.

Y10.2.2 COPPER PIPEWORK (MEDIUM-HIGH PRESSURE APPLICATIONS)

- A Application: Above ground domestic hot and cold water services water services, and fire hose reels all within the design conditions indicated below 59 mm. For specific applications refer to section B of this specification.
- B Below ground application: Copper pipework may be used underground only in situations where polyethylene pipework is unsuitable due to contamination of the land from hydrocarbons. Services in copper, which are directly buried in the ground or surrounded or bedded in concrete, to be protected by applying a corrosive protection tape. The tape to comprise a cotton carrier tape saturated with petroleum hydrocarbons with inert siliceous fillers. The tape to be spirally wrapped according to manufacturer's instructions to provide a minimum of two overlapping coats.
- C Design conditions:
- 1 Maximum temperature: 120°C
 - 2 Maximum pressure: 17 bar (gauge).
- D Tube: Material:
- 1 Material grade: Phosphorous de-oxidised copper; Cu-DHP, CR024A as defined in BS EN 1412
 - 2 Copper tube to BS EN 12449, uncoated
 - 3 Condition: Half hard R250 - Type X
 - 4 Sizes 15 to 159mm
 - 5 Kitemark Certified
 - 6 WRAS approved
 - 7 Dimensions: As table:

a Above ground:

Nominal Outside Diameter	Above Ground Pipe – Nominal Wall Thickness BS EN 124 49	Maximum Working pressure Bar (based on 65°C)
15	1.0mm	67
22	1.2mm	69
28	1.5mm	55
35	2.0mm	54
42	2.0mm	45
54	3.0mm	47
67	3.5mm	37
76	4.0mm	33
108	5.0mm	29
133	5.0mm	20
159	5.0mm	17

b Below ground: Permissible only where, polyethylene pipe is not suitable or where plastic pipework could be degraded by in ground contamination:

- Dimensions as above ground BS EN 12449 (Table 6) where it is permissible to be buried in the ground provide additional corrosion protection tape. The tape to comprise a cotton carrier tape saturated with petroleum hydrocarbons with inert siliceous fillers. The tape to be spirally wrapped according to manufacturer's instructions to provide a minimum of two overlapping coats.

E Fittings:

- 1 General:
 - a Use capillary or brazed fittings
 - b Sizes 67mm and above: Only use brazing (hard soldering).
- 2 Capillary fittings:
 - a Sizes: 15 to 54mm
 - b Type: lead and cadmium free capillary soldered
 - c Standard: BS EN 1254-1
 - d Fittings marked with manufacturer's symbol to indicate lead free solder.
- 3 Brazed fittings:
 - a Sizes: 67 to 159mm
 - b Type: Brazing (hard soldering) type employing lead free bronze welding bi-metal flange
 - c Standard: BS EN ISO 17672, type AG20
 - d Protect against electrolytic action and corrosion.

F Flanges:

- 1 15 to 159mm, bi-metal flange to BS EN 1092-3:
 - a PN 10 for working pressures up to 6 bar
 - b PN 16 for working pressures up to 10 bar
 - c PN 25 for working pressures up to 16 bar.

G Flange gaskets: joints:

- 1 Suitable for fluid being conveyed and temperature and pressure rating
- 2 Joint rings:
 - a Brass construction, corrugated and of a diameter to lie within the circle of flange bolts as Taylor's
 - b Above 10 bar: full face diameter of the flange
 - c Pre-cut and where applicable pre-drilled to suit the flange bolt centres

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- d No asbestos material are permitted.

Y10.2.3 STAINLESS STEEL PIPEWORK (LOW – MEDIUM PRESSURE WATER SERVICES)

- A Applications: Use following materials for domestic hot and cold-water services, potable and non-potable water applications as follows:
- B Standards: Stainless steel to BS EN 10088-2:
- 1 For normal environment use:
 - a Type 316L (1.4404)
 - b Type 316 (1.4401)
 - 2 Non-potable water in marine or highly chlorinated corrosive environments use: Type F44 grade 6% Mo (1.4547).
- C Design conditions:
- 1 Temperatures:
 - a Maximum temperature: 100°C
 - b Minimum temperature: -20°C
 - 2 Working pressures: 16 bar max.
- D Tube:
- 1 Standard:
 - a Seamless: BS EN 10297-2
 - b Welded: BS EN 10296-2
 - 2 Condition: BS EN 10088-2; Heat treated, pickled, lightly cold rolled code 2B
 - 3 Approvals:
 - a WRAS,
 - b Drinking Water Inspectorate
 - c Kitemark Certified
 - 4 Dimensions: NB – 15-108mm.

Nominal Outside Diameter (mm)	Nominal Wall Thickness (mm)
15	1.0
18	1.0
22	1.2
28	1.2
35	1.5
42	1.5
54	1.5
76	2.0
89	2.0
108	2.0

- E Fittings:
- 1 Capillary fittings:
 - a 15 to 54 Tungsten inert gas (TIG) welded capillary fittings to BS EN 1011-3
 - 2 Press-fit:
 - a Only use for above ground services where specifically permitted in section B of this specification for specific applications. For essential installation instructions refer to Part 3 of this specification.
 - b Sizes: 15 to 108 mm
 - c Maximum working pressure: 10 bar

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- d Type: Proprietary crimped press fit system with suitable sealing ring
 - e Suitable Manufacturers
 - Pegler
 - Gerberit
 - f Fittings manufacture:
 - Materials: 316L Stainless steel
 - Water: Type 1 fittings with black EPDM "O" seal rings
 - Leak check: Fittings to incorporate a "leak before test" facility to identify any joints that have been left un-pressed
 - Electrical continuity: Fittings to incorporate full electrical continuity
 - g Install to manufacturer's recommendations:
 - Fittings to be marked with manufacturer's symbol for installed identification
 - h Provide the client with manufacturer's recommended press fitting tools.
- 3 Flanged Joints
- a Sizes: 65 – 108 flanged fittings (BS EN 1092-1):
 - b Pressure ratings:
 - PN 10 for working pressures up to 7 bar
 - PN 16 for working pressures up to 10 bar
 - PN 25 for working pressures up to 16 bar.
 - c Joint rings to be:
 - suitable for potable water,
 - WRAS approved a
 - Suitable for design pressures and temperatures required.
 - Pre-cut and pre-drilled to suit the flange bolt centres.
- 4 Screwed joints: Screwed joints are not permitted.

Y10.2.4 METAL PIPE HANGERS AND SUPPORTS

- A Support pipework from the building structure in conformance with HVCA specifications TR/20 (all parts), TR11 and BS 13480.
- B Design supports in accordance with BS EN 13480-3 section 13 so that they:
 - 1 Support the weight of the pipework, insulation and equipment connected to it
 - 2 Control the movement of the pipework
 - 3 Direct and transfer the static and dynamic loadings into the supporting structure.
- C Ensure that materials used are compatible with the pipeline materials.

Y10.2.5 TRAPEZE PIPE HANGERS

- A Description: Shop or field-fabricate pipe-support assembly made from galvanised mild-steel angles with galvanised mild steel hanger rods, nuts, saddles, and U-bolts.
- B Comply with BS EN 13480-3 section 13.

Y10.2.6 METAL FRAMING SYSTEMS

- A Metal framing systems: Basis-of-design product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - 1 Flamco
 - 2 Unistrut Corporation
 - 3 Tyco International, Ltd
- B Description: Shop or field-fabricated galvanised pipe support assembly for supporting multiple parallel pipes:

- 1 Standard: BS EN 13480
- 2 Channels: Continuous slotted steel channel with inturned lips
- 3 Channel nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel
- 4 Hanger rods: galvanised continuous-thread rod, nuts, and washer made of carbon steel or stainless steel
- 5 Metallic coating: Electroplated zinc or hot-dipped galvanized.

Y10.2.7 THERMALLY INSULATED PIPEWORK SUPPORT INSERTS

- A Brackets on pipework and ductwork which is insulated to have proprietary made heavy density phenolic foam (with zero ODP) circular rings or flat sections, of equal thickness to the insulation, inserted between the bracket and pipe or duct.
- B The inserts to incorporate a factory applied metal spreader plate and a Class 0 vapour barrier. The length of the insert to extend outside the bracket by at least 50mm each side.
- C Where pipework expansion takes place on roller chairs, the insert to extend the full expansion distance plus 15mm and an outer galvanised sheet steel casing of suitable thickness to be secured to the insert to prevent damage.
- D On pipework systems operating at elevated temperatures the inserts to be suitable for the operating conditions.
- E Vapour barriers to be continuous over the inserts and in the case of roller chairs, under the outer galvanised sheet casing.
- F Pipework insert density is to be as follows:

Pipe size (mm)	Density (kg/m ³)
Up to 100	80
Over 100	120

- G Inserts for MTHW and HTHW and steam services to be constructed from calcium silicate.
- H Insert length: Extend 50 mm beyond sheet metal shield for piping operating below ambient air temperature.

Y10.2.8 PIPE STANDS

- A General requirements for pipe stands: Shop or field-fabricated assemblies made of manufactured hot dipped galvanised corrosion resistant components to support roof-mounted piping.
- B Compact pipe stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C Low-type, single-pipe stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D High-type, single-pipe stand:
 - 1 Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration
 - 2 Base: Stainless steel
 - 3 Vertical members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods
 - 4 Horizontal member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E High-type, multiple-pipe stand:
 - 1 Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration
 - 2 Bases: Stainless steel

- 3 Vertical members: Hot dip galvanised steel channels
- 4 Horizontal member: Hot dipped galvanised steel channel
- 5 Pipe supports: Galvanized-steel, clevis-type pipe hangers.

F Curb-mounted-type pipe stands: Shop or field-fabricated pipe supports made from structural steel shapes, continuous thread rods, and rollers, for mounting on permanent stationary roof curb.

Y10.2.9 EQUIPMENT SUPPORTS

A Description: Welded, shop or field fabricated equipment support made from structural carbon-steel shapes.

Y10.2.10 EXPANSION LOOPS - STEEL

- A Application: For use in steel pipework systems where there is sufficient space.
- B Provide expansion loop in the material and finish of the associated pipeline. Size the loop to limit the total stress set up in the material of the pipe wall to less than 69 MPa. Supply expansion calculations and anchor loads for approval by the CA.
- C For Victaulic pipework: Provide for expansion and contraction of grooved IPS steel piping system by using loops consisting of (8) Victaulic Style 77 Flexible couplings, (4) Victaulic grooved end 90 degree elbow, and grooved end pipe spools provided in water systems to 110°C in accordance with Victaulic recommendations for expansion compensation.

Y10.2.11 EXPANSION LOOPS - COPPER

- A Application: For Copper pipework systems where there is sufficient space.
- B Provide expansion loop in the material and finish of the associated pipeline. Size the loop to limit the total stress set up in the material of the pipe wall to less than 51.5 MPa. Supply expansion calculations and anchor loads for approval by the CA.

Y10.2.12 MECHANICAL EXPANSION JOINTS

- A Expansion joints may be of the restrained or unrestrained type with welded, screwed or flanged ends as appropriate.
- B Manufacturers: Subject to compliance with operating parameters select products from one of the following manufacturers:
- 1 Pipe Solutions Ltd
 - 2 Teddington Precision Engineering
 - 3 BOA Flexible Solutions Ltd
 - 4 Valves Instruments Plus
 - 5 <insert name>.
- C Design: Products to comply with the following:
- 1 capable of not less than 5000 complete reversals of movement at the given working conditions
 - 2 manufacturer to produce calculations to that effect, in full compliance with EJMA (Expansion Joint Manufacturers Association).
 - 3 test pressure 1.5 times the design working pressure without deformation.
 - a Refer to specification section B for the design working pressures of each of the pipework systems.
- D Standards:
- 1 BS 6129, Part 1
 - 2 EJMA Standards

Y10.2.13 UNRESTRAINED AXIAL EXPANSION JOINTS

A For applications see part 3.

B Construction: Stainless steel bellows, with stainless steel to all wetted parts suitable for use on steel, stainless steel or copper pipework systems:

- 1 Convolutions: thick wall spirally wound, multi-ply construction
- 2 Inner Ply: corrosion resistant 316L /316Ti stainless steel.
- 3 Inner Sleeves (where required see part 3): Stainless steel
- 4 Outer shroud (where required see part 3): Carbon steel
- 5 Weep hole: fail safe device for critical services such as MTHW, HTHW and steam
- 6 Ends for Steel Pipework
 - a DN 65-600mm: Carbon Steel Flanged BS EN 1092-1
 - b DN15-50mm: stainless steel screwed: BS21
 - c Grooved Ends:
 - Victaulic Style 150 slip-type expansion joint,
 - Victaulic Series 155 expansion joint consisting of a series of specially grooved pipe nipples joined in tandem with Victaulic Style 77 flexible couplings.
- 7 Ends for Copper/stainless steel pipework used for domestic water services
 - a DN 65-600mm: stainless steel Flanged BS EN 1092-1
 - b DN15-50mm: Stainless steel Screwed: BS21
 - c Press-fit: DN 15 -108mm. Use press-fit couplings only where press-fit pipework is permitted.
- 8 Use WRAS approved models for potable, cold and hot water services.

C Operating parameters:

- 1 Sizes: DN 40 to 600mm
- 2 Flange Pressure rating:
 - a PN25: 120°C/25 bar to 300°C/15 bar max
 - b PN16: 120°C/16 bar to 300°C/ 9.6 bar max.
 - c PN10: 120°C/10 bar to 300°C/6.0 bar max
- 3 PED Category: Sound Engineering Practice (SEP) or Non PED
- 4 Standard: Complies with PED 97/23/EC "Pressure Equipment Directive"
- 5 For domestic water services: Approval to WRAS.

D Typical Dimensions and Compression: Actual values to be provided by selected manufacturer

Nominal Diameter (DN)	Approx Installation Length (mm)	Axial Compression (mm)	Spring Rate Ax (N/mm)
15	200	25	34
20	200	25	35
25	200	25	36
32	210	25	38
40	220	25	40
50	250	25	76
15	330	50	17
20	330	50	17
25	330	50	18
32	340	50	19
40	340	50	22
50	370	50	37
65	350	40	90

Nominal Diameter (DN)	Approx Installation Length (mm)	Axial Compression (mm)	Spring Rate Ax (N/mm)
80	350	40	105
100	350	40	152
125	350	40	161
150	350	40	230
200	350	40	272
250	350	40	386
300	350	40	434
350	350	40	535
400	350	40	688
450	350	40	764
500	350	40	1053
600	350	40	1236

Y10.2.14 RESTRAINED EXPANSION JOINTS

A For applications see part 3.

B Construction: Stainless steel bellows, with stainless steel to all wetted parts suitable for use on steel, stainless steel or copper pipework systems:

- 1 Convolutions: thick wall spirally wound, multi-ply construction
- 2 Inner Ply: corrosion resistant 316L /316Ti stainless steel.
- 3 Standard of construction: EMJA.
- 4 Weep hole: fail safe device for critical services such as MTHW, HTHW and steam
- 5 Ends for Steel Pipework
 - a DN 40-600mm: Carbon Steel Flanged BS EN 1092-1
 - b Grooved Ends:
 - Victaulic Style 150 slip-type expansion joint,
 - Victaulic Series 155 expansion joint consisting of a series of specially grooved pipe nipples joined in tandem with Victaulic Style 77 flexible couplings.
- 6 Ends for Copper/stainless steel pipework used for domestic water services
 - a DN 40-600mm: stainless steel Flanged BS EN 1092-1
 - b Press-fit: DN 15 -108mm. Use press-fit couplings only where press-fit pipework is permitted.
- 7 Only use WRAS approved models for potable, cold and hot water services.

C **Lateral Type Expansion Joints:** Comprise thick wall spirally wound multi-ply construction, fitted with threaded tie bars and low friction self-lubricating hemispherical nuts, allowing movement in two planes. Refer to standard details.

- 1 Physical Properties:
 - a Typical Dimensions and deflections: Actual values to be provided by selected manufacturer

Nominal Diameter (DN)	Installation Length(mm)	Lateral Deflection (mm)	Force to Deflect (N)
40	600	25	80
50	600	25	80
65	600	25	100
80	700	25	150

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Nominal Diameter (DN)	Installation Length(mm)	Lateral Deflection (mm)	Force to Deflect (N)
100	700	25	170
125	750	25	290
150	750	25	700
200	800	25	1400
250	800	25	2500
300	1000	25	3600
350	1000	25	3980
400	1000	25	5100
450	1000	25	7200
500	1000	25	9650

NOTE: Force to deflect assumes 1m between hinge pins of 2 units

- b Length: As table above. Add 300mm for each extra 25mm deflection
- c Flange Pressure rating:
 - PN25: 120°C/25 bar to 300°C/15 bar max
 - PN16: 120°C/16 bar to 300°C/9.6 bar max.
 - PN10: 120°C/10 bar to 300°C/6.0 bar max

D **Angular Type Expansion Joints:** Incorporate a carbon steel hinged restraining bar. They are of the thick wall spirally wound multi-ply construction and be used in pairs or threes. All hinge pins to be PTFE coated to reduce friction and prevent corrosion.

1 Typical Dimensions and deflections: Actual values to be provided by selected manufacturer

Nominal Diameter (DN)	Installation Length (mm)	Angular Deflections (deg)	Force to Deflect (N)
40	200	5	41.5
50	133	5	41.5
65	133	5	50.5
80	133	5	157.0
100	133	5	304.0
125	199	5	217.2
150	199	5	331.8
200	212	5	749.7
250	212	5	1344
300	212	5	2135
350	230	5	2945
400	230	5	4220
450	240	5	6070
500	250	5	8105

Force: assume 1m between hinge pins of 2 units.

- a Length: As table above.
- 2 Flange Pressure rating:
 - a PN25: 120°C/25 bar to 300°C/15 bar max

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- b PN16: 120°C/16 Bar to 300°C 9.6 Bar max.
- c PN10: 120°C/10 bar to 300°C/6.0 bar max

E **Gimbal Type Expansion Joints:** For movement in two planes use gimbal expansion joints in pairs or in combination with one angular Expansion joint. Hinge pins to be PTFE coated to reduce friction and prevent corrosion:

1 Typical Dimensions and deflections: Actual values to be provided by selected manufacturer

Nominal Diameter (DN)	Installation Length (mm)	Angular Deflections (deg)	Force to Deflect (N)
40	200	5	41.5
50	180	5	41.5
65	180	5	50.5
80	180	5	157.0
100	180	5	304.0
125	225	5	217.2
150	225	5	331.8
200	250	5	749.7
250	250	5	1344
300	250	5	2135
350	270	5	2945
400	270	5	4220
450	290	5	6070
500	300	5	8105

Force: assume 1m between hinge pins of 2 units

- a Length: As table above.
- 2 Flange pressure rating:
 - PN25: 120°C/25 bar to 300°C/15 bar max
 - PN16: 120°C/16 bar to 300°C/ 9.6 bar max.
 - PN10: 120°C/10 bar to 300°C /6.0 bar max.

Y10.2.15 PIPELINE ANCHORS AND GUIDES

A For applications and design conditions refer to part 3

B Construct anchors as follows and as indicated on the drawings:

- 1 Steel pipe: Use one of the following
 - a Mild steel straps or heavy "U" bolts secured to channel section permanently fixed to the building structure
 - b Two slip on flanges bolted through an interposed mild steel channel attached to the building structure with flanges finally welded to the pipe.
- 2 Copper pipe: Use two flanges in pipe run, bolted through an interposed mild steel channel section firmly attached to the building structure
- 3 Plastic pipe: Seek guidance from pipework system manufacturer. Plastic coated over-straps to clamp pipework to mild steel channel section firmly attached to the building structure may be used if acceptable to manufacturer.

Y10.2.16 SERVICES CROSSING BUILDING EXPANSION JOINTS

- A Provide expansion joints at points where services cross building movement joints and anchor on one side of joint to accommodate the building movement. Co-ordinate these expansion provisions with pipework expansion joints necessary for thermal movement of the pipework itself.
- B Brackets, guides and supports each side of the flexible joint to be so arranged that services crossing the building expansion joint remain symmetrical and correctly aligned.

Y10.2.17 FLEXIBLE CONNECTIONS GENERAL

- A For applications refer to part 3.
- B Manufacturers: Subject to compliance with the operating parameters select products from one of the following:
 - 1 Pipe Solutions
 - 2 Teddington Precision Engineering
 - 3 BOA Flexible Solutions Ltd
 - 4 Engineering Products and Solutions Ltd
- C Certification: Provide an up to date and valid compliant certificate. Manufacture to identify the following within the moulded casing:
 - 1 Manufacturer
 - 2 Approval number (coinciding with that shown on the certificate).
 - 3 Country of origin
 - 4 Type and batch number
 - 5 Serial number
 - 6 Date of manufacture
 - 7 Pressure rating
 - 8 Colour code
- D Standards:
 - 1 Compliant with PED (Pressure Equipment Directive)
 - 2 CE marked.

Y10.2.18 RUBBER FLEXIBLE CONNECTION DOMESTIC WATER SERVICES

- A Application: Butyl rubber flexible connections for water, drinking water, cold and warm wastewater, seawater, cooling water, also with chemical additives for water treatment up to 90° C.
- B Do not use for all kinds of mineral oil products, cooling water with added oil containing corrosion preventatives, oily compressor air.
- C Construction
 - 1 Single convolution tube: Butyl, non-permeable, elec. conductive with steel wire reinforced faces
 - 2 Reinforcement: Nylon textile cord, Butyl rubberized, non-hardening
 - 3 Cover: Standard or use weather resistant for external applications
 - a Standard: Butyl, ozone proof, warmth resistant, elec. conductive
 - b Weather resistant: Perbunan rubber with Chlorophen
 - 4 Flanges: swivelling, carbon steel, zinc plated and yellow chromated
 - 5 Design Life: 15 years, continuously operating at 70°C
 - 6 Burst pressure: 40 bar g minimum at 70°C
- D Standards:
 - 1 WRAS approved
 - 2 DIN 4809
 - 3 Flanges: Carbon Steel PN 16 BS EN 1092-1

- 4 Maximum Pressure/Temperature: (do not use simultaneously at both maximum pressure and temperature)
 - Sizes 25 -200mm: 10 bar/90°C
 - Sizes 250-600mm: 6 bar/90°C
- 5 Max test pressure: 1.5 x working pressure
- 6 Max Vacuum: 3mmHg

Y10.1.1 RUBBER FLEXIBLE CONNECTION LTHW & CHILED WATER SERVICES

- E Application: Rubber flexible connections for permanent stress through hot heating water, cooling water and hot air.
- F Do not use for drinking water, cooling water with oil containing additives, oily compressor air, permanent effect of steam, corrosion preventative.
- G Construction:
- 1 Single convolution Liner tube: EPDM/Perbunan , hot water resistant, non-permeable, conductive with steel wire reinforced faces.
 - 2 Reinforcement: Polymer textile cord, hot water and hydrolysis proof or corrosion resistant steel wire mesh
 - 3 Cover: Standard or use weather resistant for external applications
 - a Standard: EPDM, ozone proof, warmth resistant, elec. conductive
 - b Weather resistant: Perbunan Rubber with Chlorophen
 - 4 Flanges: swivelling, carbon steel, zinc plated and yellow chromated
 - 5 Design Life: 15 years, continuously operating at 100°C
 - 6 Burst pressure: 50 bar g minimum at 100°C
- H Standards:
- 1 DIN: 4809
 - 2 Flanges: PN 16 BS EN 1092-1
 - 3 Maximum Working pressure/temperatures:
 - a 10 bar up to 100° C,
 - b 6 bar up to 110° C,
 - c temporarily up to 130° C.
 - 4 Maximum Pressure/Temperature: (do not use simultaneously at both maximum pressure and temperature)
 - Sizes 25 -200mm: 10 bar/90°C
 - Sizes 250-600mm: 6 bar/90°C
 - 5 Max test pressure: 1.5 x working pressure
 - 6 Max Vacuum: 3mmHg
 - 7 Flame resistant

Y10.2.19 STAINLESS STEEL TYPE FLEXIBLE CONNECTORS FOR TEMPERATURES ABOVE 100°C

- A Description: For temperatures above 100°C Flexible Connection must not be manufactured from Rubber. Connection to be of stainless-steel thick wall spirally wound multi-ply construction to provide the required noise and vibration reduction. The flexible to be 130mm long and provided with Van Stone ends and swivel flanges. This type of Flexible Connection is suitable for installations where the pump is on "solid" AV mounts.

Y10.2.20 FLEXIBLE CONNECTORS FOR USE WITH EQUIPMENT ON SPRING TYPE SUPPORTS

- A For installations where the pump and/or pipe work is on spring type supports, the flexible connector to be as indicated above, lateral type unit with a double membrane to give greater flexibility for this type of installation.

Y10.2.21 FLEXIBLE HOSES

- A Provide only where indicated on the drawings. Rubber type has limited life and temperature. Rubber type not suitable for potable water services. Stainless steel type not suitable for elevated chlorine levels in excess of 200ppm.
- B Manufacturers: Subject to compliance with the operating parameters select products form one of the following:
- 1 Pipe Solutions
 - 2 Spirax Sarco
 - 3 BOA Flexible Solutions Ltd
- C Rubber type: Comprise unreinforced 3mm thick EPDM rubber liner with a stainless-steel braid. Fittings are swaged using AISI 304 stainless steel ferrules suitable for design temperatures -10°C to 100°C.
- D Stainless steel type: Comprise longitudinally welded thin wall stainless steel (AISI 321) convoluted tube with stainless steel (AISI 304) braid. Fittings to suit pipework size and material. Suitable for temperatures 100 – 130°C.

Y10.2.22 PIPEWORK SLEEVES GENERAL

- A Application: Provide sleeves for all pipework passing through walls or floors. Refer to standard details and part 3 of this specification.

Y10.2.23 PIPE SLEEVES THROUGH FIRE BARRIERS

- A Application: Where pipes 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 also to standard details and part 3 of this specification for installation details.

Y10.2.24 PIPE SLEEVES THROUGH ACOUSTIC BARRIERS, ENCLOSURES AND PLANTROOMS

- A Application: Provide sleeves on pipes which are contained in walls, ceilings or floors which are acoustic barriers, or through acoustic enclosures, or plantroom walls, floors or ceilings. Refer to standard details and part 3 of this specification.

Y10.2.25 PIPEWORK PENETRATIONS THROUGH THE BUILDING ENVELOPE

- A Application: Where ducts or pipes penetrate external walls roofs and floors provide a galvanised steel sleeve and an angle iron flange or plate, sealed to the duct, pipe and structure, suitable for flashing. Refer to standard details and part 3 of this specification.

Y10.2.26 INTUMESCENT FIRE COLLARS FOR PLASTIC PIPES

- A Application: For plastic pipework with OD greater than 54mm provide intumescent fire collars fitted to the outsides of the wall or floor through which the pipework passes. Comply with the following to ensure that the installation achieves the minimum fire rating of the intervening wall or floor:
- 1 Building Regulations
 - 2 Manufacturer's installation instructions
 - 3 Tested to BS 476 Pt 20 or BS EN 1366-3
 - 4 Approvals: ETA-10/0404
 - 5 CE marked
- B Install fire collars to the pipework on both sides of the structure to achieve, 1, 2 3 or 4 hours fire protection (insulation and integrity) as defined by the fire compartmentation drawings and the Building Regulations. Suitable manufacturers:

- 1 Mann McGowan
 - 2 Quelfire
 - 3 Hilti
 - 4 Rockwool
 - 5 Promat
 - 6 PFC Corofil
- C Suitable for the following Plastic pipework types from 55mm to 315mm and wall thickness as indicated for the pressure rating of the pipework.:
- 1 PVC
 - 2 MDPE
 - 3 HDPE
 - 4 ABS
 - 5 PE
- D Construction: In general, these fire sleeves should comply with the following:
- 1 Manufacture: Specifically manufactured to suit the outside diameter of the pipe to which they are to be applied
 - 2 Technical details:
 - a Fixing: Surface fixed
 - b Application temperature range: -5 to +50°C
 - c Temperature resistance: -20 to 100°C
 - d Reaction to Fire class (BSEN 13501-1): Class E
 - 3 Fitting: Cylindrical in shape and closely, neatly and uniformly fit the pipe to which they are applied. (maximum 10mm gap).
 - 4 They should be of robust construction consisting of a continuous powder coated, galvanised or stainless steel flexible shell containing high performance graphite based intumescent material which reacts under the influence of heat to exert pressure on the pipe as it softens to form a carbonaceous char which provides an effective insulation plug thus preventing smoke and fire passing through to the adjoining compartment.
 - 5 Provide integral toggles to tighten up the collar and provide built in fixing lugs to secure the collar to the structure.
 - 6 Casings should not distort during the specified period of fire resistance.
 - 7 Product to be suitably permanently labelled to indicate that it is part of the fire integrity of the wall or floor and that removal would compromise the fire safety of the building and its occupants.

Y10.2.27 FIRE RESISTANT INSULATED SLEEVE

- A Application use for insulate metal or plastic pipes pass through a fire rated wall. Suitable for up to 2 hours fire insulation and integrity. Use fire rated collars where a higher standard of fire resistance is required or where OD of pipe exceeds 169mm. Refer to standard details for installation details.
- B Comply with the following to ensure that the installation achieves the minimum fire rating of the intervening wall or floor:
- 1 Building Regulations
 - 2 Manufacturer's installation instructions
 - 3 Tested to BS 476 Pt 20 or BS EN 1366-3
 - 4 Approvals: ETA-10/0404
 - 5 CE marked
- C Install fire sleeves to the pipework within the wall construction, 1 or 2 hours fire protection (insulation and integrity) as defined by the fire compartmentation drawings and the Building Regulations. Suitable manufacturers:
- 1 Mann McGowan
 - 2 Quelfire
 - 3 Hilti

- 4 Rockwool
 - 5 Promat
 - 6 PFC Corofil
- D Suitable for the metallic or the following plastic pipework types from 55mm to 169mm and wall thickness as indicated for the pressure rating of the pipework.:
- 1 PVC
 - 2 MDPE
 - 3 HDPE
 - 4 ABS
 - 5 PE
- E Construction: In general, these insulated fire sleeves should comply with the following:
- 1 A combination of mineral wool and a graphite intumescent material with a factory applied reinforced aluminium foil facing.
 - 2 Manufacture: Specifically manufactured to suit the outside diameter of the pipe to which they are to be applied
 - 3 Technical details:
 - a Length: 300 mm (cut to suit depth of wall)
 - b Thickness: 25mm to 100mm to suit adjoining thermal insulation
 - c Maximum pipe diameter OD: 169mm
 - d Application temperature range: -5 to +50°C
 - e Temperature resistance: -20 to 100°C
 - f Reaction to Fire class (BSEN 13501-1): Class E
 - 4 Provide a traffolyte engraved sign adjacent to the penetration to permanently indicate that the sleeve is part of the fire integrity of the wall or floor and that removal would compromise the fire safety of the building and its occupants.

Y10.3 PART 3 - EXECUTION

Y10.3.1 PIPING INSTALLATIONS

- A Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on co-ordination drawings.
- B Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D Install piping in accordance with British standards and in particular B &ES (formerly HVCA) technical guidance Guides to Good Practice:
- 1 TR3: Jointing of copper and its alloys
 - 2 TR5: Welding of Carbon Steel Pipework
 - 3 TR6: Site pressure testing of Pipework
 - 4 TR11: Use of plastic pipework
 - 5 TR13: Water Treatment BSRIA Technical Note
 - 6 TR20 Installation and Testing of Pipework systems
 - 7 TR/20/1 Low Temperature Hot water heating
 - 8 TR20/2 Medium Temperature Hot Water Heating
 - 9 TR20/3 High Temperature Hot water
 - 10 TR20/4 Hot Water Services
 - 11 TR20/5 Cold water
 - 12 TR20/6 Chilled Water
 - 13 TR20/7 Condenser water
 - 14 TR20/8 Steam and Condensate
 - 15 TR20/9 Natural Gas
 - 16 TR20/10 Fuel Oil.
- E Install piping in accordance with the following:
- 1 Above accessible ceilings to allow sufficient space for ceiling panel removal
 - 2 To permit valve servicing
 - 3 At indicated/specified slopes
 - 4 Install piping free of sags and bends
 - 5 Install fittings for changes in direction and branch connections
 - 6 Install piping to allow application of insulation.
- F Select system components with pressure rating equal to or greater than system operating pressure.
- G Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- H Install drains, consisting of a tee fitting, DN 20 ball valve, and short DN 20 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- I Install piping at a uniform gradient of 0.2 percent upward in direction of flow.
- J Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- K Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- L Install valves according to Y11 Pipeline ancillaries.
- M Install unions in piping, DN 50 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- N Install flanges in piping, DN 65 and larger, at final connections of equipment and elsewhere as indicated.

- O Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install DN 20 nipple and ball valve in blowdown connection of strainers DN 50 and larger. Match size of strainer blow-off connection for strainers smaller than DN 50.
- P Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in this section.
- Q Identify piping as specified in Y32 Mechanical plant and equipment identification.
- R Install sleeve seals for piping penetrations of walls, ceilings and floors. Comply with requirements for sleeve seals specified in this section Install cover plates for piping penetrations of walls, ceilings, and floors. Comply with requirements for cover plates specified in Y11.
- S Do not connect pipework of different metals directly together without providing appropriate protection against galvanic corrosion.

Y10.3.2 PIPEWORK INSTALLATION GENERAL REQUIREMENTS

- A Install all pipework:
 - 1 To follow the routes and approximate positions indicated on the drawings.
 - 2 With following minimum clearances between the pipe or lagging, and adjacent surfaces always ensuring that there is sufficient space for thermal insulation and flanges:

a Walls:	25mm
b Ceilings:	100mm
c Finished Floors:	165mm
d Adjacent Pipes, both insulated;	50mm
e Adjacent Pipes, both un-insulated:	150mm
f Insulated Pipes to adjacent conduit or trunking;	25mm
g Un-insulated Pipes to adjacent conduit or trunking:	100mm
h Adjacent Pipes, one only insulated:	75mm
i Un-insulated Pipes adjacent to electrical cables not in conduit/ trunking:	150mm
j Insulated Pipes adjacent to electrical cables not in conduit/ trunking:	100mm
 - 3 With adequate gradients to facilitate draining and venting of the pipeline.

a Steam and Condense:	1 in 250 fall in direction of flow
b Pumped Condense:	1 in 400
c Liquids:	1 in 400
d Gas:	1 in 100 fall in direction of flow
e Compressed Air:	1 in 40 above ground
	1 in 80 in ducts or trenches
 - 4 Clean and free from corrosion and scale and internal obstructions.
 - 5 With ends to be cut square, reamed, free from burrs and finished full bore.
 - 6 Plumb, straight, symmetrical and at right angles to or parallel to adjacent walls.
 - 7 Provide segregation of services in accordance with BS 8313.
- B Space to be provided around pipework as needed for the installation of insulation and/or future maintenance. Do not enclose pipework in a common insulating covering.
- C Bond metallic pipework systems in accordance with the IET Regulations for Electrical Installations.
- D Provide adequate storage facilities to ensure that tube does not suffer any deterioration from its as new delivered condition.
- E Provide sufficient unions and flanges to install and dismantle sections of pipework. Take care when placing unions to allow freedom to spring apart. Do not install unions and flanges in inaccessible positions.
- F Install piping so as to allow for expansion. Make connections to coils, pumps and other equipment in such a manner as to eliminate undue strains in piping and equipment. Provide necessary fittings and bends to avoid springing of pipes during assembly.
- G Cold draw of steel piping or cold stretch of expansion bellows to be made during pipework erection as required by the design of the expansion arrangements.

- H Bends and tees to be of the easy sweep type except at air vents, drain points and dead legs where square tees should be used.
- I Vertical rising pipework to be supported at the base or, as indicated, to withstand the total weight of the riser. Do not use branches from risers as a means of support for the riser.
- J Paint ferrous pipework (insulated or uninsulated) and other pipework to the requirements of this specification (refer to Y10.3.18).

Y10.3.3 HANGERS AND SUPPORTS GENERAL

- A Piping support must account for expansion and contraction, vibration, dead load of piping and its contents, and bracing requirements.
- B Install the following pipe attachments:
 - 1 Adjustable galvanised steel clevis hangers for individual horizontal piping less than 6 m long
 - 2 Adjustable roller hangers and spring hangers for individual horizontal piping 6 m or longer
 - 3 Pipe roller: For multiple horizontal piping 6 m or longer, supported on a trapeze
 - 4 Spring hangers to support vertical runs or within plantrooms
 - 5 Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe
 - 6 On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- C Install hangers for piping with the maximum spacings as indicated. Provide pipework supports such that the maximum intervals listed in this section are not exceeded. Ensure that minimum stress is imposed upon the pipelines. Provide additional supports on either side of pipework ancillaries including valves, strainers, heating coils and other pipeline mounted equipment.
- D Drop rod sizes not to be less than 10mm and be capable of taking the static and dynamic loads imposed with a safety factor of 2.
- E Obtain approval from the CA for any fixings to structural concrete or structural steel work.
- F Fixings to the building structural element: Generally, use "Redheads", rawlbolts clamps adaptors or similar approved heavy fixings and white metal rawlplugs or approved plastic type plugs for light loads. Do not drill structural steelwork for pipe supports. Do not use supports with backplate in floor screed situations.
- G Pipework to be securely supported, singly or in groups, graded to levels required for venting and draining and having regard to the requirements for differential expansion, anchors and guides and thermal insulation sizing.
- H Pipework exposed to view to have approved brackets or clips of neat appearance, screw fixed to the wall at intervals to give uniform spacings and neat appearance.
- I Hydronic mains in builderswork ducts to be supported on rollers and chairs using fabricated mild steel brackets (painted) or galvanised channel sections with allowance for building-in or bolting-on to the surface of the duct wall.
- J Pipes at ceiling level or in roof spaces to be suspended from rods or straps using adjustable galvanised mild steel hangers with swinging joints or purpose-made angle iron cradles or other steel sections. Clips to be used on cold pipes with rollers and chairs on hot pipes and where expansion cannot be readily taken upon hanging brackets.
- K Exposed external steel brackets to be fabricated then hot dipped galvanised before erection, unless otherwise specified.
- L Allowance for the fitting of pipe covering protection saddles specified to be made at the support positions on mains that require continuous unbroken weatherproof or vapour proof seal finish, as in the case of chilled water or cold-water pipes. Where required, fit load-bearing insulation at supports at the time of erecting this pipework.
- M Pipework of 65mm size and larger subjected to expansion and contraction and hung from supports to be suspended on swivel hangers unless otherwise agreed with the client.

- N Hangers for horizontal pipework at high level to be supported from mild steel angle or channel sections or approved proprietary devices, suitable for building-in or otherwise securing to the structure. Adjustable galvanised mild steel hangers to be used. Drop rods not less than 10mm diameter. Pipe rings of malleable cast iron or fabricated steel, made in halves and secured by bolts or screws. Alternatively, malleable iron hinged pipe rings may be used, but calliper hooks will not be permitted.
- O Pipework supports to be arranged so that minimum stress is imposed upon the pipelines. Provide additional supports on either side of pipework ancillaries and equipment such as valves, strainers, heating coils and other pipeline mounted equipment. It is important to ensure that all materials used for pipework supports are compatible with the pipeline materials.

Y10.3.4 HANGER AND SUPPORT SCHEDULE

- A Comply with BS EN 13480 for pipe-hanger selections and applications that are not specified in piping system Sections. Use of "C" clamps and beam clamps of "C" pattern are prohibited.
- B Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- C Use non-metallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- D Use carbon-steel pipe hangers and supports, or metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- E Use stainless-steel pipe hangers for stainless steel pipework and attachments also use for hostile environment applications.
- F Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- G Use padded hangers for piping that is subject to scratching.
- H Use thermal-hanger shield inserts for insulated piping and tubing.
- I Horizontal piping hangers and supports: Unless otherwise indicated and except as specified in piping system sections, install the following types:
 - 1 Adjustable, steel hangers: For suspension of non-insulated or insulated, stationary pipes DN 15 to DN 750
 - 2 Adjustable, Swivel-Ring Band Hangers: For suspension of non-insulated, stationary pipes DN 15 to DN 200
 - 3 U-Bolts: For support of heavy pipes DN 15 to DN 750
 - 4 Pipe stanchion saddles: For support of pipes DN 100 to DN 900, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe
 - 5 Single-pipe rolls: For suspension of pipes DN 25 to DN 750, from two rods if longitudinal movement caused by expansion and contraction might occur
 - 6 Adjustable roller hangers: For suspension of pipes DN 65 to DN 600, from single rod if horizontal movement caused by expansion and contraction might occur
 - 7 Complete pipe rolls: For support of pipes DN 50 to DN 1050 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary
 - 8 Pipe roll and plate units: For support of pipes DN 50 to DN 600 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary
 - 9 Adjustable pipe roll and base units: For support of pipes DN 50 to DN 750 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- J Vertical piping clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1 Extension pipe or riser clamps: For support of pipe risers DN 24 to DN 600
 - 2 Carbon or alloy steel riser clamps: For support of pipe risers DN 20 to DN 600 if longer ends are required for riser clamps.

- K Hanger rod attachments: Unless otherwise indicated and except as specified in piping system sections, install the following types:
- 1 Steel turnbuckles: For adjustment up to 150 mm for heavy loads
 - 2 Swivel turnbuckles: For use with MSS Type 11, split pipe rings.
- L Building attachments: Unless otherwise indicated and except as specified in piping system sections, install the following types:
- 1 Steel or malleable concrete inserts: For upper attachment to suspend pipe hangers from concrete ceiling
 - 2 Side-beam or channel clamps: For attaching to bottom flange of beams, channels, or angles
 - 3 Centre-beam clamps: For attaching to centre of bottom flange of beams
 - 4 Steel-beam clamps with eye nuts: For attaching to bottom of steel I-beams for heavy loads
 - 5 Linked-steel clamps with eye nuts: For attaching to bottom of steel I-beams for heavy loads, with link extensions
 - 6 Malleable-beam clamps with extension pieces: For attaching to structural steel.
- M Saddles and shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1 Steel-pipe-covering protection saddles: To fill interior voids with insulation that matches adjoining insulation
 - 2 Protection shields: Of length recommended in writing by manufacturer to prevent crushing insulation
 - 3 Thermal-hanger shield inserts: For supporting insulated pipe.
- N Spring hangers and supports: Unless otherwise indicated and except as specified in piping system sections, install the spring hangers as indicated in section Y31 of this specification.

Y10.3.5 FIXING SYSTEMS

- A Supports to be solidly fixed to the structure using proprietary manufactured drill and plug fixing devices with removable bolt or screw. Wooden plugs, loose fill or masonry nails will not be allowed. Gun fixings will only be allowed when specifically approved.
- B At each support fixing a steel channel or angle iron section to be secured to the structure from which pipework, ductwork supports and brackets and equipment supports are attached.
- C Holes in steelwork supports and brackets to be formed by correctly drilling, using the recommended tolerances for that which is to be inserted. Flame gun / welding torch holes burned out will not be allowed.
- D Where individual pipes up to 50mm diameter are supported on timber or lightweight walls, ceilings or partitions, brackets to be of the screw fixing type and primary channel or angle iron brackets must not be used. On solid / heavy walls over 100mm thickness, individual pipework may be supported by the use of built-in, long shank holderbats or pipe brackets.
- E Supports from the building structural steelwork to be made using proprietary manufactured steel clamps or girder lugs. Direct drilling of the structural steelwork will not be allowed.
- F Where high level pipework, ductwork and equipment cannot be supported from the structure, a primary steelwork supporting frame to be provided, fixed to the floor and of suitable design to spread the load evenly, from which all pipework and equipment is supported.
- G Powder-actuated fasteners: Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- H Mechanical-expansion anchors: Insert-wedge-type, stainless steel anchors, for use in hardened Portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- I Use largest size of bolt, screw to suit diameter of hole in equipment to be fixed. Ensure that fixings are tested for tensile loading to BS 5080. This particularly applies to expanding anchors.

- J Plastic plugs of suitable size and length to be used. Use screws to BS 1210. For fixing to concrete, brickwork or blockwork use sheradized steel wood screws but in damp or exposed situations use greased brass screws.
- K Obtain approval if shot fired fixings are proposed.

Y10.3.6 PIPEWORK SUPPORT SPACING

- A The following table applies to pressurised metallic pipework listed below:

- 1 Steel: BS EN 10255; BS EN 10217, BS EN 10216
- 2 Copper: BS EN 1057 +A1, BS EN 12449
- 3 Cast Iron: BS 4622
- 4 Ductile Iron: BS EN 545, BS EN 598 +A1 and BS EN 969
- 5 Stainless steel: BS EN 10312.

Nominal pipe bore (mm)	Maximum support spacing (m)					
	Steel pipe		Copper pipe		Iron pipe	
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
Up to 15	1.8	2.4	1.2	1.8	-	-
20	2.4	3.0	1.4	2.1	-	-
25	2.4	3.0	1.8	2.4	-	-
32	2.7	3.0	2.4	3.0	-	-
40	3.0	3.6	2.4	3.0	-	-
50	3.0	3.6	2.7	3.0	1.8	1.8
65	3.7	4.6	3.0	3.6	-	-
80	3.7	4.6	3.0	3.6	2.7	2.7
100	3.7	4.6	3.0	3.6	2.7	2.7
125	3.7	5.4	3.0	3.6	-	-
150	4.5	5.4	3.6	4.2	3.7	3.7
200	5.0	6.0	-	-	3.7	3.7
250	5.0	6.0	-	-	4.5	5.4
300	6.1	10.0	-	-	8.0	10.0
50	10.0	12.0	-	-	-	-
400	10.5	12.6	-	-	-	-
450	11.0	13.2	-	-	-	-
500	12.0	14.4	-	-	-	-
600 & above	14.0	16.8	-	-	-	-

- a Note: For refrigeration pipework 15 - 28mm support copper pipework on continuous plastic-coated cable tray.

- B The following table applies to plastic pressure pipework listed below:

- 1 Polyethylene - BS EN 12201 parts 1, 2 and 5,
- 2 ABS - BS 5391-1
- 3 PVC-U BS EN 1452,DIN 4102
- 4 PEX BS 7291-3, DIN 4102
- 5 Note the following classifications:

- a Class O - (Non-pressure)
 - b Class B - 6.0 Bar
 - c Class C - 9.0 Bar
 - d Class D - 12.0 Bar
 - e Class E - 18.0
 - f Class 6 & 7 pressure varies refer to BS.
- 6 For plastic pipework in Table below the vertical spacing may be a maximum of 1½ times the horizontal spacing
- 7 For UPVC and ABS pipework reduce spacing if operating at temperatures above 20°C in accordance with manufacturers requirements for temperature above 60°C provide continuous supports.

PIPE BORE (mm) Nominal	MAXIMUM SUPPORT SPACING (m)			
	UPVC PIPE & ABS PIPE		POLYETHYLENE PIPE	
	Class O, B, C	Class E, 6, 7	BS 6730	BS 6437
	Class O, B, C	Class E, 6, 7	BS 6730	BS 6437
Upto 15	-	0.6	0.4	0.6
20	-	0.65	0.4	0.6
25	-	0.75	0.4	0.6
32	-	0.8	0.45	0.7
40	-	0.9	0.45	0.7
50	1.0	1.0	0.55	0.85
65	1.2	1.2	0.55	0.85
80	1.2	1.2	-	0.9
100	1.3	1.3	-	1.1
125	1.5	1.5	-	-
150	1.6	1.6	-	1.3
175	1.7	1.8	-	-
200	1.9	2.0	-	-
225	2.0	2.0	-	-
250	2.0	2.0	-	-
300	2.4	2.4	-	-
350	2.4	2.4	-	-
400	2.4	2.4	-	-
450	2.4	2.4	-	-
above 450	2.4	2.4	-	-

C The following table applies to pressure polypropylene pipework:

- 1 Polypropylene - BS EN ISO 15874-2, DIN 8077/08:

POLYPROPYLENE TO BS ISO 4065:1996, BS 2782-11:Method 1121B:1997, ISO 161-1:1996, BS ISO 11922-1:1997			
PIPE OUTSIDE DIAMETER mm	MAXIMUM SUPPORT SPACING (m)		
	20°C	60°C	100°C
20	0.6	0.5	0.4
25	0.7	0.6	0.5

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POLYPROPYLENE TO BS ISO 4065:1996, BS 2782-11:Method 1121B:1997, ISO 161-1:1996, BS ISO 11922-1:1997			
PIPE OUTSIDE DIAMETER mm	MAXIMUM SUPPORT SPACING (m)		
	20°C	60°C	100°C
32	0.8	0.7	0.6
40	0.9	0.8	0.7
50	1.0	0.9	0.8
63	1.2	1.0	0.9
90	1.3	1.2	1.0
110	1.5	1.3	1.1

D The following table applies to sanitation and rainwater pipework listed below:

- 1 Iron Piping EN877: +A1
- 2 PVC-U Soil Pipes BS EN 1329-1
- 3 PVC-U Waste Pipes BS EN 1329-1
- 4 PVC-U Rainwater BS EN 12200-1
- 5 Polypropylene BS EN 1451-1
- 6 Vulcathene (Polypropylene).

PIPE BORE (mm) Nominal	MAXIMUM SUPPORT SPACING (m)					
	UPVC & Polypropylene		Vulcathene		Iron Piping	
	horizontal	vertical	horizontal	vertical	horizontal	vertical
20	-	-	-	-	-	-
25	-	-	-	-	-	-
32	0.5	1.2	-	-	-	-
40	0.5	1.2	1.2	1.5	-	-
50	0.9	1.2	1.4	1.5	1.5	3.0
63	-	-	-	-	-	-
80	0.9	2.0	1.5	1.5	1.5	3.0
100	1.0	2.0	1.8	1.5	1.5	3.0
125	-	-	-	-	1.5	3.0
150	1.0	2.0	1.8	1.5	1.5	3.0
175	-	-	-	-	-	-
200	-	-	-	-	1.5	3.0

- E Assess the amount of movement in the pipework systems taking into account building structural movement due to thermal changes, settlement, imposed loads and wind effects. Where pipework crosses the building movement joints design the pipework expansion system to cater for both structural and thermal pipework movement. The resultant displacement will be the sum of both.
- F Where possible make provision for movement due to thermal expansion and contraction by natural changes in the direction of pipework. Provide expansion loops or mechanical joints if necessary.
- G Submit all calculations showing the amount of movement to be accommodated, including building movement together with details of the loads imposed upon the anchors. Allow for the most extreme maximum and minimum temperature conditions that the pipework systems may be exposed to which are often greater than the normal flow and return operating conditions.

- H Position anchors and guides to contain all movement and resist the maximum loads imposed. Ensure locations are compatible with the structural movement joints.
- I Locate anchors and guides at points which prevent excess stresses on pipework, joints and equipment connections.
- J Provide pipework movement joints where there are building movement joints or where necessary to cater for building settlement.
- K Provide flexible connections to all pump suction and discharges, chillers, condensers and other centrifugal reciprocating or vibrating equipment such as air handling units and also where marked on the drawings. Provide flexible connections where equipment is mounted on anti-vibration mounts or inertia bases. Refer also to standard details and schematic drawings.
- L Ensure that all mechanical expansion joints are accessible for maintenance and replacement.

Y10.3.7 PIPEWORK SLEEVES GENERAL

- A Pipes passing through walls, ceilings or floors to be encircled with a built-in sleeve having minimum sufficient clearance to permit movement of the pipe. Sleeves through walls to finish flush with the finished surface of the wall and in finished areas be fitted with chromium plated cover plates.
- B Sleeves through floors and ceilings to have a supporting flange at the top end and in finished areas to be fitted with purpose made white plastic cover plates except in locations where floors are likely to be flooded or washed where the sleeve to extend 50mm above the finished floor and to have its edge rounded or bevelled.
- C Sleeves to be manufactured from the same material as the pipe. Where pipework is insulated, the pipe sleeve to be of sufficient size to allow the thermal insulation to pass between the pipe and the sleeve over its entire length.

Y10.3.8 PIPE SLEEVES THROUGH FIRE BARRIERS

- A Application: Where pipes 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 also to standard details and part 3 of this specification for installation details.
- B Refer to the following clauses for suitable fire stopping materials for the building in of the components.
 - 1 Fire stop mortars: Y90.2.15
 - 2 Fire stop Intumescent putty pads: Y90.2.14
 - 3 Intumescent Sealant: Y90.2.16.
- C Fire sleeves for uninsulated metal pipes:
 - 1 Sleeves: Use 1.2mm metallic sleeves same material as the pipe
 - 2 Build the metal sleeve into the wall and surround in a fire stopping mortar
 - 3 Pack the open annular gap between the sleeve and the pipe with intumescent sealant and present a neat appearance
 - 4 Materials: Subject to approval and must comply with the Building Regulations.
 - 5 All proprietary products to be as listed in the Association for Specialist Fire Protection (ASFP) Red book for its intended purpose.
- D Fire sleeves for insulated metal or PVC pipes:
 - 1 Sleeves: Use the same 1.2mm steel sleeves
 - 2 Build the metal sleeve into the wall and surround in a fire stopping mortar.
 - 3 Surround the pipe in a proprietary fire-resistant insulated sleeve, length to suit the wall depth (Rockwool and graphite) to protrude 25-50mm from the wall finish and butt against the adjoining pipework standard thermal insulation. Insulated sleeve to be same thickness as adjoining insulation and the joint to be sealed with tape.

- 4 Pack the open annular gap between the metallic sleeve and the insulated pipe with intumescent sealant material for the full length of the penetration and present a neat appearance
- 5 Materials: Subject to approval and must comply with the Building Regulations.
- 6 All proprietary products to be as listed in the Association for Specialist Fire Protection (ASFP) Red book for its intended purpose
- 7 Provide a traffolyte engraved sign adjacent to the penetration to permanently indicate that the sleeve is part of the fire integrity of the wall or floor and that removal would compromise the fire safety of the building and its occupants.

E Intumescent fire collars for uninsulated plastic pipes:

- 1 Provide proprietary manufactured fire collars for plastic pipework greater than 54mm OD passing through fire rated constructions.
- 2 Refer to part 2 for details.
- 3 Sleeves: Use 1.2mm mild steel
- 4 Build the metal sleeve into the wall and surround in a fire stopping mortar
- 5 Pack the open annular gap between the sleeve and the pipe with intumescent sealant and present a neat appearance
- 6 Materials: Subject to approval and must comply with the Building Regulations.
- 7 All proprietary products to be as listed in the Association for Specialist Fire Protection (ASFP) Red book for its intended purpose.
- 8 Product to be suitably permanently labelled to indicate that it is part of the fire integrity of the wall or floor and that removal would compromise the fire safety of the building and its occupants.

F Intumescent fire collars for insulated plastic pipes:

- 1 Provide proprietary fire collars for insulated plastic pipework greater than 54 OD passing through fire rated constructions.
- 2 Sleeves: use 1.2mm metal sleeves
- 3 Build the metal sleeve into the wall and surround in a fire stopping mortar.
- 4 Surround the pipe in a proprietary fire-resistant insulated sleeve (Rockwool and graphite) or Elastomeric Thermal Insulation such as Armaflex AF, (Rockwool and graphite).
- 5 Butt collar against the adjoining pipework standard thermal insulation. Insulated sleeve to be same thickness as adjoining insulation and the joint to be sealed with tape.
- 6 Pack the open annular gap between the metallic sleeve and the insulated pipe with intumescent sealant material for the full length of the penetration and present a neat appearance
- 7 Materials: Subject to approval and must comply with the Building Regulations.
- 8 All proprietary products to be as listed in the Association for Specialist Fire Protection (ASFP) Red book for its intended purpose
- 9 Product to be suitably permanently labelled to indicate that it is part of the fire integrity of the wall or floor and that removal would compromise the fire safety of the building and its occupants.

Y10.3.9 PIPE SLEEVES THROUGH ACOUSTIC BARRIERS, ENCLOSURES AND PLANTROOMS

- A** Sleeves on pipes which are contained in walls, ceilings or floors which are acoustic barriers, or through acoustic enclosures, or plantroom walls, floors or ceilings, to be packed with a 12mm thick resilient neoprene inner sleeve around the pipe or duct and filled with a non-setting mastic compound. The outer edges of the sleeve to be made airtight by sealing with a dense non-setting mastic compound.
- B** Where such barriers are also fire barriers the material to comply with the clauses for fire rated sleeves.

Y10.3.10 PIPEWORK PENETRATIONS THROUGH THE BUILDING ENVELOPE

- A** Provide, where ducts or pipes penetrate external walls roofs and floors, a galvanised steel sleeve and an angle iron flange or plate, sealed to the duct, pipe and structure, suitable for flashing.
- B** Penetrations through flat roofs to be completely watertight and permit water to drain freely onto the roof. Provide a suitable sheet metal cravat with the skirt extended beyond the flashing. The flange and cravat to be weather resistant.

- C Penetrations through flat roofs to be completely watertight and permit water to drain freely onto the roof. Provide a suitable sheet metal cravat with the skirt extended beyond the flashing. The flange and cravat to be weather resistant.
- D Provide, where penetrations are made through pitched roofs a purpose made metal roof sheet, complete with a flashing plate and cravat.

Y10.3.11 EXPANSION SYSTEMS INSTALLATION

- A Assess the amount of movement in the pipework systems taking into account building structural movement due to thermal changes, settlement, imposed loads and wind effects.
- B Where possible make provision for movement due to thermal expansion and contraction by natural changes in the direction of pipework.
- C Where natural flexing of the pipework is not practical, accommodate thermal expansion, contraction and building movement by the use of expansion loops or mechanical expansion joints. Use loops only where practical and where there is sufficient space to accommodate the calculated dimensions of the loops.
- D The application, location and type of joints to be in accordance with BS 6129 Part 1 and EJMA guidelines
- E Prior to installation, submit to the CA for approval the exact locations and working drawing details including magnitude of expansion, magnitude and direction of thrusts of all expansion joints, guides, anchors and other associated equipment. Engage the services of a specialist to design and select the appropriate expansion devices. Design the anchors to withstand the forces imposed upon them.
- F Connect to items of plant and equipment in such a way that no stress is placed on the equipment or its connections.
- G Do not use branch connections as anchor points.
- H Install expansion joints in full accordance with the manufacturer's recommendations and instructions.
- I Allow for the most extreme maximum and minimum temperature conditions that the pipework systems may be exposed to which are often greater than the normal flow and return operating conditions.
- J Anchors and guides: Position anchors and guides to contain all movement and resist the maximum loads imposed. Ensure locations are compatible with the structural movement joints.
- K Building Movement Joints: Where pipework crosses the building movement joints design the pipework expansion system to cater for both structural and thermal pipework movement. The resultant displacement will be the sum of both.
- L Flexible connections: Provide flexible connections to all pump suction and discharges, chillers, condensers and other centrifugal reciprocating or vibrating equipment such as air handling units and also where marked on the drawings. Provide flexible connections where equipment is mounted on anti-vibration mounts or inertia bases. Refer also to standard details and schematic drawings.
- M Cold Draw: During installation apply 50% cold draw/ pull (hot systems liable to expansion) or 50% cold compression (cold systems liable to contraction) when fully anchored so for:
 - 1 Hot pipework: Extend the expansion device (at installation ambient temperatures) by 50% of the expected expansion and pull pipework together so that the pipework is under 50% negative stress and expands to 50% positive stress when operating at the higher working temperature.
 - 2 Cold pipework: Cold compress the expansion device (at installation ambient temperature) by 50% of the expected expansion and connect to joining pipework so that the pipework is under 50% positive stress and contracts to 50% negative stress when operating at the lower working temperature.
- N Pipework guides and supports
 - 1 Ensure that the spacing of the supports does not exceed the centres given in this specification. On multi-pipework installations using a common support use the centres required by the smallest bore pipework
 - 2 Support vertical rising pipework at the base or, as indicated, to withstand the total weight of the riser.

- O Ensure that all mechanical expansion joints are accessible for maintenance and replacement.
- P Anchors and pipe guides must be firmly installed prior to filling and pressure testing the system. Ensure that test pressure does not exceed the test pressure of the installed joints.
- Q Expansion joints must not be strained by torsion (unless fitted with torsion protection). This is particularly important for the installation of expansion joints with threaded sockets.
- R Protect the bellows against damage and dirt (e.g. welding chips, plaster or mortar splatter).
- S Steam pipelines should be installed in such a way that water hammer is avoided. This is achieved by means of adequate drainage, by correct insulation, by avoiding water pockets and by installing the pipeline with an inclination.
- T Expansion joints with internal sleeves must be installed with consideration given to the fluid flow direction.
- U Avoid the installation of expansion joints in the immediate proximity of pressure reducers, superheated steam coolers and shut-down valves, if high frequency vibrations are to be expected due to turbulence. Otherwise, special precautions must be taken (e.g. heavy-walled sleeves, perforated disks, etc.).
- V Obtain design calculations and selections for types of joint from the pipeline manufacturer for the following specific pipework systems:
 - 1 Plastic pipework
 - 2 Grooved end pipework
 - 3 Press-fit pipework.

Y10.3.12 EXPANSION LOOP INSTALLATION:

- A Use loops only where practical and where there is sufficient space to accommodate the calculated dimensions of the loops.
- B Construct expansion loops to the same pipework specification and material as the connecting pipework system.
- C Where space is limited or pipework is larger than 100mm it may be more practical to use manufactured expansion joints rather than loops.
- D Fabricate bends from a single length of pipe or by welding fittings if expansion loops are too large

Y10.3.13 MECHANICAL EXPANSION JOINT INSTALLATION

- A Application: Where natural flexing of the pipework or expansion loops are not practical, accommodate thermal expansion and building movement by the use of manufactured expansion joints.
- B Expansion joints may be of the restrained or unrestrained type with welded, screwed or flanged ends as appropriate.
- C Comply with manufacturer's installation instructions and guidelines.
- D Indicate the location of expansion joints and their corresponding anchors and guides on the installation drawings.
- E Engage the services of the manufacturer to visit the site and inspect the final installation prior to cold pressure testing.

Y10.3.14 PIPELINE ANCHORS AND GUIDE INSTALLATION

- A Provide anchors and guides in suitable locations to control the direction and effects of movement of the pipework systems and to resist stresses and loading on pipework due to forces acting on the pipework system. Use materials similar or compatible with the pipework systems. Comply with the requirements of BS EN 13480-3.

- B Provide guides in accordance with the expansion joint manufacturer's requirements and BS EN 13480. Ensure that movement of pipework is directed from anchor points towards loops and bellows and ensure thrust is along the line of the pipework. Provide a friction reducing material between adjacent metal surfaces subject to movement.
- C Ensure that the anchor and guide components are suitably sized and designed to withstand and transfer the pipeline thrust. Comply with the general requirements of BS EN 13480.
- D Submit details of the anchor loads, anchor and guide locations, method of fixing to the structure and design details for review by the structural engineer prior to commencement of the works.
- E Provide thrust blocks and suitable anchors where pipework internal pressures are not contained by the jointing system.
- F For plastic pipework, grooved pipework, and push-fit installations obtain design recommendations from the pipework system manufacturer for all anchoring and expansion provisions.

Y10.3.15 SERVICES CROSSING BUILDING EXPANSION JOINTS

- A Provide expansion joints at points where services cross building movement joints and anchor on one side of joint to accommodate the building movement. Co-ordinate these expansion provisions with pipework expansion joints necessary for thermal movement of the pipework itself.
- B Brackets, guides and supports each side of the flexible joint to be so arranged that services crossing the building expansion joint remain symmetrical and correctly aligned.

Y10.3.16 AXIAL (UNRESTRAINED) EXPANSION JOINTS INSTALLATION:

- A Application: LTHW, MTHW, LP Steam and potable hot and cold domestic water services. Designed to accommodate thermal pipe expansion in an axial direction. Axial expansion joints only to be used in positions where pressure thrust (which can be very high) can be contained by adequate anchor points contained by the building fabric. Use axial joints when:
 - 1 Expansion is between 25-75mm
 - 2 There are simple straight lengths of pipework
 - 3 Anchor loads can be accommodated by the structure.
- B If anchors forces cannot be accommodated or become too expensive design the pipework routing to utilise restrained expansion joints.
- C Recommended guide spacing and tolerances as described in BS 6219/BS EN 13480 are critical and must be strictly adhered to.
- D Use joints with internal sleeves when:
 - 1 There are high frequency vibrations
 - 2 There is a risk of turbulent flow
 - 3 Flow velocity is ≥ 3.0 m/s for pipework $\geq$ DN150.
- E Use an external shroud to give mechanical protection in plantrooms or when located in areas of industry that could damage the bellows.
- F Special requirements for axial type expansion joints:
 - 1 Must be used with anchors
 - 2 Pipe runs must be straight
 - 3 Only one expansion joint may be located between two anchors
 - 4 Calculate and install guides at the correct locations with respect to the expansion joint
 - 5 Position main anchors as follows:
 - a At the beginning and end of the pipelines
 - b At points of change of direction
 - c At locations of branch take-offs
 - 6 Position intermediate anchors between main anchors when:

- a Movement capacity of one axial expansion joint is insufficient
- b Several expansion joints are required in one pipework section
- 7 Provide for anchor stress reduction by applying cold pull/compression
- 8 Axial expansion joints may be supplied with pre-set cold draw and fitted with temporary installation bars which must be removed after installation.
- 9 Ensure that the flow direction is correct when units are fitted with internal sleeves.

Y10.3.17 RESTRAINED (LATERAL, ANGLE AND GIMBAL) TYPE EXPANSION JOINTS:

- A Application: LTHW, MTHW, HTHW, steam and domestic hot water services. For domestic water services use all stainless-steel type. The joints are fitted with tie bars or hinges to prevent the joint moving axially. Refer to standard details for typical applications.
- B Install in changes of pipework direction (90°):
 - 1 use for compensating lateral movements perpendicular to expansion joint axis
 - 2 also use for compensating circular oscillations
 - 3 do not use for axial movements
 - 4 always arrange at right angles to the pipeline being compensated.
- C **Angular (Hinged) type:** Effectively a hinged bend for movement in one plane of up to $\pm 5^\circ$. Typically used for complex multi-plane pipework and can cater for large movements.
 - 1 Always use in sets of two or three
 - 2 Use when there is a change of pipework direction through 90° or more. Typical hinged applications are:
 - a 2-pin "Z" system: 2 angular joints used in an offset between two pipe runs that are parallel to each other
 - b 3-pin "Z" system: 3 angular expansion joints are used adjacent to a small offset between two pipe runs that are parallel to each other
 - c 3-pin "L" system: 3 angular expansion joints are used at the change of direction between two long pipe runs that are $\geq 90^\circ$ to each other.
- D **Gimbal type.** Can accommodate movement in any plane
 - 1 Use in pairs where there is a change of pipe direction
 - 2 Use 2 pin system to compensate for perpendicular movements in short pipeline sections.
- E Restrained expansion joints are designed to absorb the full pressure thrust of the expansion joint convolutions. They can accommodate movement in a lateral direction. They must not be used for axial movement.
- B Design the expansion joint restraints to absorb the full pressure thrust of the expansion joint convolutions
 - 1 Double tied units must be fully supported over their entire length when installing
 - 2 Must be used with anchors (intermediate type only required)
 - 3 Install at pipework changes of direction typically at 90° to each other
 - 4 Only one expansion joint may be located between two anchors
 - 5 For lateral movement in one plane the pipe movement must always be perpendicular to the axis of the pins.
 - 6 Position anchors and guides to suit the anticipated extent and direction of movements
 - 7 Calculate and install guides at the correct locations with respect to the expansion joints.
 - 8 Provide for anchor stress reduction by applying cold pull to the adjoin pipework but note:
 - a Leave a gap in the pipework after the expansion joint has been installed
 - b Joints should not be compressed or extended
 - c Joints should be installed at their correct installation length
 - 9 Ensure that the flow direction is correct when units are fitted with internal sleeves.
 - 10 Expansion joints may be supplied with 50% pre-stressing but the actual temperature of the pipeline must be taken into account when pre-stressing is applied and adjusted accordingly.

Y10.1.1 FLEXIBLE CONNECTION INSTALLATION

- A Application: Fit flexible connections to all pump suction and discharge connections, chillers, condensers and other centrifugal, reciprocating or vibrating equipment and also anywhere it is marked on the drawings, and where anti-vibration mounts, inertia bases are fitted.
- C Test flexible connections for Noise and Vibration reduction capabilities, with certification being submitted to the engineer for approval prior to the order being placed.
- D Fit flexible connections as close to the source of vibration as practicable. The pipe at the other end of the flexible connection is to be a fixed point. This is necessary to reduce the noise, vibration and resonances from the distribution pipework to the building fabric and prevent any stresses in the pipework from being transmitted upon the pump or vibrating equipment. To ensure correct alignment, employ a spool piece during installation.
- E Flanges: Use removable flanges, suitably profiled, to control the convolution shape. Plate flanges must not be used.
- F To avoid over tightening and damaging the sealing face of the rubber bellows ensure that the flanges make metal to metal contact with its mating flange when fully tightened.
- G Use threaded and adjustable tie bars with rubber top hat washers where the working pressure exceeds 1.5 bar g.
- H Pumps: Comply with manufacturer's recommendation when untied flexibles are used to prevent forces being exerted on to the pump casing and AV mounts.

Y10.3.18 PIPE JOINT CONSTRUCTION

- A Join pipe and fittings according to the following requirements and as identified in Y10 clauses specifying piping systems.
- B Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D Soldered joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E Brazed joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F Threaded joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows.
- G Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
- H Damaged threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- I Welded joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- J Flanged joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- K Grooved joints: Grooved Victaulic mechanical couplings and fittings may be used in lieu of welded or threaded piping with black steel or galvanized steel pipe provided the system media is suitable for a gasket elastomer that is produced by the coupling manufacturer. The grooved ends to be clean, and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing.

Y10.3.19 PARTICULAR REQUIREMENTS FOR PRESS-FIT CRIMPED JOINTS

- A Press-fit crimped joints: Comply with manufacturer's installation recommendations and methodology outlined in this specification:
- 1 Only use press-fit type crimped joints where specifically indicated in section B and for only those applications indicated in this specification
 - 2 Carbon steel press-fit piping and fittings are not permitted in any circumstances
 - 3 Where press-fit type crimped joints are permitted the following procedures must be strictly adhered to. Failure to comply with these procedures will render the pipework installation unacceptable and the whole of the installation must be replaced:
 - a Each installing operative must be trained by the specific press-fit product manufacturer. Provide manufacturer's on-site installer training and certification for each operative
 - b Ensure that only the manufacturer's recommended press-fit tools are used with the correct jaw profile
 - c Each operative must have a manufacturer supplied socket-depth gauge and permanent marker pen to pre-mark the minimum socket depth onto the tube surface prior to installation to ensure that all fittings are to full depth
 - d Each installing operative to be allocated with a job-specific installer number that is put onto or adjacent to every completed press-fit joint to allow for a continual installation audit
 - e Comply with the manufacturer's minimum spacing requirements between fittings
 - f Do not carry out any soldering, brazing or welding of tube within 300mm of previously installed press-fit joints. Protect seal rings from excess heat.

Y10.3.20 FITTINGS & WORKMANSHIP

- A Changes in diameter:
- 1 Swaged joints and stub weld joints will not be accepted except where small diameter pipe bosses or sockets are provided for thermostats, gauges, service test points etc, on pipework greater than 50mm diameter. Where this applies the hole in the pipework to be drilled to the correct size to suit the tolerance required for welding. Flame gun or blow torch burnt holes will not be accepted
 - 2 Changes in diameter, tees, branches and bends other than pulled bends and sets to be made using standard manufacturers fittings described elsewhere
 - 3 Changes in diameter of horizontal pipework to be formed eccentrically to allow draining and venting.
- B Sets and pulled bends:
- 1 Sets and pulled bends are not be allowed in:
 - a Galvanised pipework
 - b Ungalvanised tube 65mm and above.
 - 2 Sets and bends to be free from kinks and ripples and formed in a suitable bending machine
 - 3 Wherever possible the tube to be bent cold by the gradual application of pressure to a radius of not less than 3 times the nominal bore.
- C Steel screwed fittings:
- 1 Fittings to be of the long, easy sweep pattern for bends, tees and branches on pipework carrying liquids and square and short radius type, on pipelines carrying gases
 - 2 Long screw connections, running nipples, reducing nipples, backnuts, will not be accepted.
- D Flanges and unions:
- 1 Where pipeline ancillaries and connections to equipment have only imperial flanged connections to BS 10, then the mating flange must also comply with BS 10 to the appropriate table to suit the operating pressure and temperature. In all other respects flanges to be to the relevant part of BS EN 1092
 - 2 Flanges and flanged joints to be welded or screwed to the pipework to give a flush joint for the joint ring and to be correctly aligned and true, to prevent undue stress on the fixing bolts during erection
 - 3 Unions to be bronze-to-bronze spherical seat.
- E Equipment and pipework draining and venting:

- 1 Equipment to be provided with drains and vents, which are to be accessible from outside the casing
- 2 Adequate drains and vents to be provided in pipework to drain and vent the pipework system
- 3 Where pipework sections can be isolated drain and vent points to be provided to facilitate draining down and venting of that section of pipework
- 4 Drain points to be fitted with a drain cock to BS 2879 with hose union and removable key
- 5 Drain points on medium and high temperature pipework to be fitted with a flanged valve and blank flange
- 6 Provide dirt pockets at the bottom of all pipework risers, comprising 300mm long full-bore pipe with gate valve and drain cock. The gate valve to be line size up to a maximum of 50mm
- 7 In plantrooms a 30 m length of 25mm flexible rubber / armoured hose pipe to be provided and fixed to the wall. The hose to have a connection to match the drain valves.

F Overflows and condensate drains:

- 1 Equipment which has a continuous or intermittent discharge of wastewater to have an overflow / drain connection and discharge pipe which is to fall continuously to the nearest gully
- 2 Overflow / drains to be the same diameter as the connection size as equipment and increased as soon as possible to 25mm
- 3 A 150mm diameter by 150mm high tundish to be provided adjacent to the equipment into which the overflow / drain discharges
- 4 On connections to coils / cooling towers a water trap to be installed between the coil / cooling tower and the drain
- 5 Where more than one overflow / drain runs into a common pipework drain adequately size the drain to accommodate the combined flow rate
- 6 Provide an air break trap to each drain to comply with CIBSE TM13
- 7 Glass traps to be used in all healthcare and clean room applications.

Y10.3.21 PARTICULAR REQUIREMENTS FOR STEEL AND IRON PIPEWORK

A Upon completion of the pipework installation and before insulating paint un-galvanised ferrous and copper pipework in accordance with Y10.3.28.

B Nuts, bolts and washers for flanges:

- 1 Nuts, bolts and washers for black steel and cast-iron flanged joints to be to either BS 4190 metric series hexagonal head with threads to BS 3643 -1 or of the high tensile steel type to suit the operating pressure and temperature. On galvanised, plastic and copper / gun metal and all external pipework, flange nuts, washers and bolts to be as above but sheradized to BS 4921
- 2 The length of the bolt to determine to suit the thickness of flanges and joints to protrude the nut head by 6mm maximum.

C Welding steel pipework:

- 1 Steel tube to be jointed by welding except where threaded joints are permitted in sizes 50mm and below for certain categories of pipework (Refer to each category specified elsewhere). Welding is mandatory for pipework which will be buried, embedded or has difficult access or is concealed under raised floors in computer room type installations
- 2 Only skilled craftsman with current certificates of competence may be used for welding pipework. Craftsman up to class 2 standard are required
- 3 Welding of flanges and pipework to comply with BS 2971 and with HVCA Code of Practice TR/5
- 4 All welds to be stamped with the operative's mark
- 5 Provide a sample welded joint from each operative for inspection prior to commencement of installation. Examine 10% of butt-welded joints by radiographic testing and 5% of all other joints. Should these tests not prove satisfactory then further welds by the same operatives to be tested and all defective welds are to be replaced until the correct standards of workmanship are demonstrated.

D Welding of stainless-steel pipework:

- 1 Cleanliness is the most important aspect of operations with stainless steel. Keep the material clean and free from contamination during storage handling and fabrication. Stainless steel should be stored under cover
- 2 Welding should be undertaken in accordance with a written procedure, with both welder and procedure qualified to the welding standard being followed. Although the manual skills are similar to those required for welding carbon steels the welder needs to adhere to the procedure for stainless steels and be familiar with the thermal characteristics and nature of flow
- 3 An inert gas must be used to protect the penetration bead of single – sided full penetration welds. It is essential for optimum corrosion performance. Argon or a 90% nitrogen/10% hydrogen gas mixture may be used
- 4 Ensure oxygen and water contents below 25ppm at the weld location (including tack welds.) Shielding should be maintained until the metal temperature has fallen below 250°C
- 5 Provide post weld cleaning, remove crevice features and all weld heat tints by mechanical dressing or cleaning as necessary and then acid pickling and passivating the joint. Both oxide films and any chromium-depleted layers beneath them must be removed
- 6 For mechanical cleaning all abrasive media must be iron free and wire brushes must be made of a suitable grade of stainless steel to avoid contamination. Mechanically cleaned surfaces should be taken to at least a 180 grit finish
- 7 Under no circumstances should mortar cleaners based on hydrochloric acid be used on stainless steels
- 8 Examination procedures and guidance on weld acceptance criteria are to comply with. BS EN ISO 5817
- 9 After hydrostatic testing drain completely.

E Steel pipework – grooved joints:

- 1 Grooved Victaulic mechanical couplings and fittings may be used in lieu of welded or threaded piping with black steel or galvanized steel pipe provided the system media is suitable for a gasket elastomer that is produced by the coupling manufacturer
- 2 Verify that gaskets are suitable for the intended service prior to installation. Gaskets to be moulded and produced by the coupling manufacturer
- 3 The grooved coupling manufacturer's factory trained representative to provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative to periodically visit the jobsite and review installation. Contractor to remove and replace any joints deemed improperly installed
- 4 A distributor's representative is not considered qualified to conduct the training
- 5 All grooved joint couplings, fittings, valves, and specialties to be the products of a single manufacturer. Grooving tools to be of the same manufacturer as the grooved components.

F Galvanised steel pipework:

- 1 Do not weld, cut or similarly work galvanised pipework unless specifically approved by the CA.

Y10.3.22 PARTICULAR REQUIREMENTS FOR COPPER PIPEWORK

A No ferrous metals to be in direct contact with the pipework unless where connections are made to equipment or existing services of other metals. Use proprietary standard fittings where these connections are required.

B Copper capillary fittings:

- 1 Remove excess flux and solder to give a clean neat finish and to prevent verdigris.

C Copper brazing and bronze welding:

- 1 Operative Qualifications: BS EN ISO 13585
- 2 Copper joints to be silver soldered, brazed or bronze welded to suit the operating temperature and pressure and comply with the following:
 - a British Standards BS EN 14324
 - b Copper Development Association Technical Notes
 - c Welding rods, brazing filler materials fluxes etc: BS EN ISO 17672.
 - d No jointing compound or filler material is to be used within the joint or screwed locking nut.

Y10.3.23 PARTICULAR REQUIREMENTS FOR SOLVENT WELDED PLASTIC PIPEWORK

- A Always follow manufacturers' instructions. Pipe to be cut square with a fine pitch saw and internal and external burrs removed. Pipe and fitting should be abraded using clean, coarse emery cloth and cleaned with an appropriate cleaner. Apply cement in accordance with manufacturers' requirements.
- B Test pressure should not be applied for a minimum of 24 hours.
- C Joints should not be made:
 - 1 In wet conditions
 - 2 Using dirty brushes / rags
 - 3 Using inappropriate cements or cleaners.
- D Ensure adequate ventilation during assembly. Ensure correct storage and handling of pipework materials.

Y10.3.24 PARTICULAR REQUIREMENTS FOR ELECTROFUSION JOINTING OF POLYETHYLENE PIPEWORK

- A Always comply with the manufacturer's instructions.
- B Pipe ends must be cut square and de-burred. If necessary, clean the pipe ends with clean water and dry.
- C Use a mechanical scraping tool to prepare the surface of the joint. Do not use rasps / files or abrasive sheets to prepare pipe ends.
- D Assemble the joint and clamp the ends. Attach the control unit leads and ensure that the generator has sufficient fuel.
- E Commence the fusion cycle following the manufacturer's requirements. Allow the joint to cool for the required time.
- F Where electrofusion couplers are to be used for repair situations the existing main should be completely dry with no running water.

Y10.3.25 PROTECTION DURING CONSTRUCTION

- A During construction work on all pipework services, take care to prevent any foreign matter entering the pipework.
- B Open ends to be capped with the appropriate pipework fitting; wooden plugs and the like must not be used. Valves fitted on the ends of pipework are not acceptable as a means of preventing the ingress of foreign materials.
- C Failure to comply with these requirements will result in:
 - 1 pipework so left uncovered will be required to be dismantled for such lengths as the CA requests and the pipework blown through and/or cleaned at no cost to the contract.
- D Remove all cement adhering to the pipework surface and brackets. Remove scale, rust by wire brushing and paint pipework and brackets as described elsewhere in this specification.

Y10.3.26 INACCESSIBLE EMBEDDED OR BURIED PIPEWORK

- A Do not install pipework in inaccessible locations without prior approval.
- B Water Regulations Guide: Comply with the requirements of the WRAS water regulations guide. Particularly note the requirements where pipework is inaccessible or to be embedded or buried within the thickness of walls or floors. Generally, note that where pipework is inaccessible or buried:
 - 1 joints are not generally permitted in these locations.
 - a Where not possible use all welded construction
 - b Separately pressure test this section of pipework prior to concealment.

- 2 Pipework must be sleeved where passing through walls or floors.
- C Buried pipework: Comply with the requirements of section P30. Layout and identify services as NJUG guidelines for positioning and colour coding of underground utilities apparatus.
- 1 Refer to standard details
 - 2 Provide an identification marker tape laid to provide warning of service underneath.
- D Pipework in screed:
- 1 Not permitted unless fully sheathed in factory applied PVC.
 - 2 No joints are permitted.
- E Where permitted by the CA services of ferrous metal and copper, which are directly buried in the ground or surrounded or bedded in concrete are to be protected by applying a corrosive protection tape. The tape to consist of a cotton carrier tape saturated with petroleum hydrocarbons with inert siliceous fillers. The tape to be spirally wrapped according to manufacturer's instructions to provide a minimum of two overlapping coats.
- F Trenches: For the preparation of trenches in earth refer to standard details and section P30 of this specification.
- G Entry of pipework services into buildings: Refer to standard details and section P30 of this specification:
- 1 Gas pipework to enter above ground and must not pass under any foundations
 - 2 Other services to pass through a sleeve fitted with a puddle flange where necessary
 - 3 Provide puddle flanges where pipes pass through walls or floors which require proofing against liquid penetration. Comprising:
 - a A length of pipe and an undrilled flange welded onto the pipe at distance midway through the structural thickness
 - b The assembly to extend beyond both sides of the wall or floor and terminate in flanged connections
 - c Manufacture the assembly from the same class of piping as the adjoining pipework
 - d Where buried wrap the complete assembly in 2 coats of petroleum jelly impregnated tape.

Y10.3.27 PARTICULAR REQUIREMENTS FOR STEAM AND CONDENSE MAINS

- A Steam and condense mains to have a minimum of 1 in 250 fall. Ensure steam connections are taken from the top of mains to plant and equipment. Discharges from condense traps also to connect into the top of the condense main.
- B Provide drain traps at all system low points and immediately before automatic control valves on steam mains. Install traps to manufacturers' recommendations.

Y10.3.28 PIPEWORK PAINTING

- A Painting requirements:
- 1 Remove all rust and cementitious spatter before painting and comply with the relevant parts of BS EN ISO 8503.
 - 2 Paint **all** ferrous metal pipework (including uninsulated or insulated) with one coat of zinc phosphate priming paint
 - 3 Paint copper and other non-ferrous metals if uninsulated and in occupied and decorated areas of the building. In these locations use zinc chromate primer
 - 4 Do not paint plastic or stainless-steel pipework
 - 5 Do not paint galvanised finishes except for repair or where an alternative appearance is required
 - 6 Heat Resistant Paint: Use heat resistant paints for applications to surfaces over 80°C
 - 7 Where pipework is exposed to view and not to be insulated apply a suitable primer, undercoat and a finishing coating to an approved colour. Finishing coating to comprise one of the following:
 - a 2 coats of gloss paint
 - b Other specialist paint finish: if required where ambient conditions necessitate an alternative as indicated below.

- B Where pipework is insulated, and exposed to view, a paint finish is only required to the insulation if it is not encased in aluminium foil or aluminium cladding.
- C Colours: for finish paint colours comply with Y32 and seek approval from CA where pipework is exposed to view.
- D Paint materials: Use the following materials as appropriate for the applications:
- 1 VOC low solvent priming paint to BS 7956 for bare woodwork
 - 2 Red Oxide priming paint for bare iron and steelwork
 - 3 Zinc Chromate priming paint for bare copper, gunmetal and non-ferrous metals
 - 4 Zinc Phosphate priming paint for steel and galvanised iron
 - 5 Calcium Plumbate priming paint to BS 3698 for galvanized steel or composite wood/metal components
 - 6 Undercoating paint for previously primed or painted surfaces before the application of finishing coats
 - 7 Gloss finishing paint for previously primed or painted/undercoated surfaces
 - 8 Epoxy resin paint for specialist coatings requiring resistance to acids, alkalis, oils, solvents, abrasion or high humidity
 - 9 Aluminium paint to BS 388 for structural steelwork, storage vessels, heated metallic surfaces and similar applications where moisture and heat resistant properties are required
 - 10 Cold galvanizing paint for making good damage to previously galvanized surfaces and protection to galvanized materials modified during installation
 - 11 Zinc-rich metallic to BS 4652 for bare iron and steelwork where electrical conductivity has to be assured
 - 12 Black tar-based paint to BS 1070 for moisture resistant protection to metal surfaces where decorating appearance is not important
 - 13 Bitumen based coatings for cold application to BS 3416 protection to iron and steel, particularly pipelines and fittings for use in contact with potable water
 - 14 Bitumen based coatings for cold application to BS 6949 not to be used in contact with potable water.
- E Paint quality: Ensure paints used are of quality and type to suit application and that:
- 1 Primers have good adhesion, covering power, rust-inhibiting and grain filling properties
 - 2 Gloss finishing paints are of machine finish grade having high adhesion and high resistance to solvents, mineral oils, cutting oils, detergents, chipping and impact damage.
- F Painting general:
- 1 Ensure paints are applied in accordance with manufacturer's instructions and to BS 6150
 - 2 Weather and Other Conditions:
 - a Do not apply paints where weather, temperature, humidity or other conditions may have a damaging effect upon finish or paint.
 - 3 Cleaning and preparing steel surfaces for painting:
 - a Ensure metal surfaces are thoroughly cleaned, all mill and weld scale removed and finally degreased
 - b Clean steel surfaces in accordance with BS EN ISO 8503 and prepare surfaces for painting in accordance with BS EN ISO 4618.
 - 4 Application off-Site: Wherever possible ensure paint finishes applied by component manufacturers are spray applied
 - 5 Apply paint evenly and ensure finish shows no excessive brush marks, grinning, runs, sagging, ropiness or other application defects
 - 6 Cold galvanizing: Repair damage to galvanized components due to installation process, i.e. following cutting, drilling or welding, by applying 2 No. substantial coats of cold galvanizing paint
 - 7 Protection of bright machine parts: Apply a protective coating to all bright machined parts before despatch from works
 - 8 Do not remove protective coatings unless required for installation, testing or commissioning purposes and in such cases reinstate upon completion
 - 9 Repair any damaged protective coating or bright machined part, or where necessary replace damaged component
 - 10 Use and apply metal coatings in accordance with manufacturer's instructions
 - 11 Complete where possible all welding, drilling, bending and other work before metal coating.

Y10.3.29 HYDRONIC SPECIALTIES INSTALLATION

- A Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.
- C Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D Install in-line air separators in pump suction. Install drain valve on air separators DN 50 and larger.
- E Install tangential air separator in pump suction.
- F Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- G Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 1200 mm above the floor. Install feeder in minimum DN 20 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install DN 20 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.
- H Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank:
 - 1 Install tank fittings that are shipped loose
 - 2 Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.
- I Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

Y10.3.30 TERMINAL EQUIPMENT CONNECTIONS

- A Sizes for supply and return piping connections to be the same as or larger than equipment connections.
- B All terminal units and heating/cooling coils to be provided with flushing by-passes with drain valves for backflushing. Any items that will restrict the flushing procedures must be by-passed or removed. Adequate vents to be provided to enable air to be quickly purged during filling.
- C Install control valves in accessible locations close to connected equipment.
- D Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- E Install ports for pressure gauges and thermometers at coil inlet and outlet connections according to standard details.

Y10.3.31 CHEMICAL TREATMENT CLOSED WATER CIRCUITS TESTING

- A Refer to section Y12 for flushing, cleaning and water treatment.
- B Prepare hydronic piping according to Y12 and as follows:
 - 1 Leave joints, including welds, uninsulated and exposed for examination during test
 - 2 Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing
 - 3 Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens
 - 4 Isolate equipment from piping. If a valve is used to isolate equipment, ensure that its closure is capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment
 - 5 Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

Y10.3.32 DOMESTIC WATER SERVICES PIPEWORK CLEANING

- A Refer to section S12.

Y10.3.33 DISINFECTION PROCESS – DOMESTIC WATER SERVICES

- A Refer to section S12.

Y10.3.34 TESTING GENERAL

- A The Services (Mechanical, Electrical and Plumbing) Sub-Contractors are responsible for testing their complete installations and for ensuring that they are in a satisfactory condition for dynamic commissioning by their Commissioning Sub-Contractors.
- B The MEP Sub-Contractors are required to offer each system to their Commissioning sub-contractors (CSC) prior to dynamic commissioning. When the installation has been accepted as tested and complete the Commissioning Sub-Contractors may then commence the regulation, balancing and setting to work of each system.
- C In the same manner the building itself must be in a satisfactory state to enable commissioning to take place. The Contractor is required to ensure that all building works are complete prior to the dynamic commissioning of any of the air systems.

Y10.3.35 WELDS – RADIOGRAPHIC TESTING

- A Provide radiographic testing to 10% of all welds. CMS to identify a random sample of joints to be tested.
- B Welded joints to be tested in accordance with:
- 1 BS 2971
 - 2 BESA/HVCA TR/5.
- C Rectify and retest any joints that fail this test. CMS to select another 10% of welds to be tested until a batch returns 100% satisfactory results.

Y10.3.36 PIPEWORK SYSTEMS STATIC TESTING

- A Pressure testing of water carrying pipework systems to be carried out in accordance with the following standards where appropriate:
- 1 BSRIA/AG20/95
 - 2 BSRIA/BG 29/2012
 - 3 BS 6880-3
 - 4 BESA/HVCA TR/20 all Parts
 - 5 BS EN 806-4
 - 6 BS 8558.
- B Testing procedures for pipework installations:
- 1 hydraulically test after erection and before insulation is applied.
 - a For welded mains: Every weld to be hammered while under pressure and the test period may be prolonged to allow for this action being performed.
 - b Tests may be in sections as work proceeds.
 - c Pipework installations includes valves, heat exchangers and controls etc that are subject to the system pressure when in operation.
 - 2 Test pressures for working pressures:
 - a $\leq 280\text{Pa}$: twice the working pressure
 - b $> 280\text{Pa}$: $1\frac{1}{2}$ times the working pressure plus 140 kPa.
 - 3 Test pressure to be maintained for a minimum of 2 hours without loss of pressure or visible evidence of leakage.
 - 4 Equipment for testing: Use a test pump assembly with a sealing valve and associated test gauges.

- a Disconnect the pump from the system on reaching test pressure at which time the test period shall then begin.
- b Monitored the test pressure on the test gauge associated with the sealing valve pump assembly unit.
- c Test gauge: 150mm diameter

C Where insulation must be installed before the completion of the entire system it may become necessary to test in sections. Make due allowance for this by plugging off certain sections as necessary, in order that pressure testing can be carried out prior to application of thermal insulation.

Y10.3.37 TESTING DRAINAGE SYSTEMS

A Refer to section R10 & R11 of this specification and Y50.

Y11 PIPELINE ANCILLARIES

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Y11.1 PART 1 - GENERAL

Y11.1.1 RELATED DOCUMENTS

A For drawings and general provisions of the contract, including main contract preliminaries.

B Related sections include the following:

1	HVAC & Domestic Pipework:	Y10
2	Mechanical Cleaning and Chemical treatment	Y12
3	Thermal Insulation	Y30
4	Vibration isolation Mountings	Y31
5	Water Treatment systems	S12
6	Mechanical Plant and equipment identification	Y32
7	Building monitoring and management systems	Y41
8	Testing and commissioning.	Y50
9	Fixing to building Fabric	Y90.

Y11.1.2 SUMMARY

A This section relates to isolation, commissioning and regulating valves, cocks and strainers used potable and non-potable water services distribution systems. Section also includes pipework ancillaries for these services such as test points, gauges, vents and other pipework components.

B Section includes:

- 1 Isolation Valves (IV):
 - a Bronze ball valves
 - b Iron, single-flange butterfly valves
 - c Iron, grooved-end butterfly valves
 - d High-performance butterfly valves
 - e Bronze gate valves
 - f Iron gate valves
 - g Bronze globe valves
 - h Iron globe valves
 - i Lubricated plug valves.
- 2 Non return valves (NRV):
 - a Bronze lift check valves
 - b Bronze swing check valves
 - c Iron swing check valves
 - d Iron, grooved-end swing-check valves.
- 3 Regulation valves:
 - a Globe type valves
 - b Double regulating valves
 - c Metering stations
 - d Commissioning stations.
- 4 Ancillaries:
 - a Strainers
 - b Vents
 - c Drain cocks
 - d Valves for isolation of pressure gauges
 - e Relief valves
 - f Pressure gauge isolation valves
 - g Valves and ancillaries for fan coil copper connections
 - h Pressure reducing valves
 - i Differential pressure reducing valves

- j Automatic control valves
- k Radiator valves
- l Thermostatic radiator valves
- m Pressure gauges
- n Thermometers
- o Self-sealing test plugs.

Y11.1.3 DEFINITIONS

A The following abbreviations are used in this specification and on the drawings:

- 1 IV: Isolation Valve
- 2 RV: Regulating Valve
- 3 DRV: Double Regulating Valve
- 4 GV: Gate Valve
- 5 GBV: Globe Valve
- 6 BV: Ball Valve
- 7 BFV: Butterfly Valve
- 8 MS: Metering Station
- 9 CS: Commissioning set
- 10 NRV: Non-Return Valve
- 11 TRV: Thermostatic Radiator Valve
- 12 DPV: Differential Pressure Control Valve
- 13 PRV: Pressure Reducing Valve
- 14 T/P: Temperature/Pressure self-sealing test plug
- 15 CV: Automatic Control Valve.
- 16 PICV: Pressure Independent Control Valve
- 17 LPV: Lubricated Plug Valve.

Y11.1.4 PERFORMANCE REQUIREMENTS

- A Select valves and ancillaries that are suitable for the design operating temperatures and pressures indicated. Refer to section B of this specification.
- B Refer to the schematic and detail drawings which show the general location of ancillaries.
- C Provide valves on all pipework to ensure that, plant and equipment can be isolated for maintenance or repair, the distribution system can be isolated in sections, and that the systems can be properly commissioned and balanced. Refer also to BS 6683 for typical applications. The following are typical locations where valves are required:
- 1 To enable isolation of all equipment
 - 2 To enable the flow regulation of the systems
 - 3 To enable every section of pipework within the distribution system to be isolated
 - 4 To isolate, regulate and balance the flow through system components
 - 5 To enable the removal of pipeline ancillaries such as control valves, strainers, flow meters etc.
 - 6 To isolate water services to individual items of sanitary equipment or kitchen equipment
 - 7 To isolate all incoming utility services immediately inside the building.
- D Ensure that all balancing and flow regulation valves are correctly selected and installed to suit the flow rates indicated in the specification and drawings. The position of all regulating / balancing valves must be approved by the commissioning engineer prior to installation. Regulation and balancing of the systems shall be achieved by the installation of commissioning stations and isolating valves in the following locations:

- 1 A commissioning station shall be provided on the return branch or sub-circuit return main and an isolating valve shall be provided on the corresponding flow connection, flow branch or sub-circuit flow main
 - 2 The commissioning stations shall be installed to the manufacturer's recommendations, with special regard to straight pipe lengths required before and after the assembly
 - 3 A regulating valve shall be provided on the return pipe from each terminal unit and an isolating valve shall be provided on the corresponding flow connection to each terminal unit.
- E Note that in order to comply with the above, valves may be required in addition to those indicated on the drawings.
- F All valves shall be selected to ensure that they are suitable for the temperature and 1.5 times the working pressure ratings of the systems into which they are intended to be installed.
- G Provide check (non-return) valves fitted where pumps operate on an automatic changeover basis and where undesirable flow reversal can occur.
- H Unlined cast iron valves are not permitted in copper pipework.
- I Flanged valves shall have mating flanges manufactured in accordance with BS EN 1092. Bronze flanges that are flat faced must be matched with flat face pipe flanges. Composite flanges to BS EN 1092 should be used when butterfly or other 'inside bolt circle' valves are installed in copper pipework systems.
- J Use only proprietary commissioning valves for balancing purposes. Ensure that all balancing and flow regulation valves are correctly selected to suit the final flow rates indicated in the specification, schedules and drawings.
- K Only use WRAS approved valves and ancillaries on domestic water services.

Y11.1.5 SUBMITTALS

- A Provide all product data.
- B Provide detailed fabrication drawings and sketches for approval for all brackets, hangers, supports, etc. for pipework, ductwork and equipment. The drawings / sketches shall show the methods of installation, sizes and the specification of materials to be used. Where grooved joint couplings and fittings are used, these shall be specifically identified in drawings with the applicable series designation.
- C Provide details of all expansion arrangements together with supporting calculations to demonstrate that sufficient expansion facilities have been provided.
- D Provide loading details for all types of supports.

Y11.1.6 QUALITY ASSURANCE

- A Ensure that the whole installation complies with the relevant standards, including the following:
- 1 BS 10 - Specification for flanges and bolting for pipes, valves, and fittings
 - 2 BS EN 10226-1: Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads. Dimension, tolerances and designation
 - 3 BS EN 10226-2: Pipe threads where pressure tight joints are made on the threads. Taper external threads and taper internal threads. Dimension, tolerances and designation
 - 4 BS 759-1 - Valves, gauges and other safety fittings for application to boilers and to piping installations for and in connection with boilers. Specification for valves, mountings and fittings
 - 5 BS 1212-1 - Float operated valves. Specification for piston type float operated valves (copper alloy body) (excluding floats)
 - 6 BS 1212-2 - Float operated valves. Specification for diaphragm type float operated valves (copper alloy body) (excluding floats)
 - 7 BS 2767 - Specification for manually operated copper alloy valves for radiators
 - 8 BS 2879 - Specification for draining taps (screw-down pattern)

- 9 BS 5154 - Specification for copper alloy globe, globe stop and check, check and gate valves (Partially replaced by BS EN 12288)
- 10 BS 5163-2 - Valves for waterworks purposes. Stem caps for use on isolating valves and associated water control apparatus. Specification
- 11 BS 6129-1 - Code of practice for the selection and application of bellows expansion joints for use in pressure systems. Metallic bellows expansion joints
- 12 BS 6683 - Guide to installation and use of valves
- 13 BS 7350 - Specification for double regulating globe valves and flow measurement devices for heating and chilled water systems
- 14 BS EN 215 - Thermostatic radiator valves. Requirements and test methods
- 15 BS EN 331+A1: Manually operated ball valves and closed bottom taper plug valves for gas installations for buildings
- 16 BS EN 545 - Ductile iron pipes, fittings, accessories and their joints for water pipelines. Requirements and test methods
- 17 BS EN 593 + A1 - Industrial valves. Metallic butterfly valves
- 18 BS EN 598+A1 - Ductile iron pipes, fittings, accessories and their joints for sewerage applications. Requirements and test methods
- 19 BS EN 806-2 - Specifications for installations inside buildings conveying water for human consumption. Design
- 20 BS EN 806-4 - Specifications for installations inside buildings conveying water for human consumption. Installation
- 21 BS EN 837-1 - Pressure gauges Bourdon tube pressure gauges. Dimensions, metrology, requirements and testing
- 22 BS EN 877+A1 - Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings. Requirements, test methods and quality assurance
- 23 BS EN 969 - Ductile iron pipes, fittings, accessories and their joints for gas pipelines. Requirements and test methods
- 24 BS EN 1057+A1: Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications
- 25 BS EN 1092-1 - Flanges and their joints - circular flanges for pipes, valves, fittings and accessories, PN designated. Steel flanges
- 26 BS EN 1092-2 - Flanges and their joints - circular flanges for pipes, valves, fittings and accessories, PN designated. Cast iron flanges
- 27 BS EN 1092-3 - Flanges and their joints - circular flanges for pipes, valves, fittings and accessories, PN designated. Copper alloy flanges
- 28 BS EN 1171 - Industrial valves – cast iron gate valves
- 29 BS EN 1213 - Building valves. Copper alloy stopvalves for potable water supply in buildings. Tests and requirements
- 30 BS EN 1254-1 - Copper and copper alloys - plumbing fittings, fittings with ends for capillary soldering or capillary brazing to copper tubes
- 31 BS EN 1254-2 - Copper and copper alloys - plumbing fittings, fittings with compression ends for use with copper tubes
- 32 BS EN 1329-1 - Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Unplasticized polyvinylchloride (PVC-U)
- 33 BS EN 1451-1 - Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Polypropylene (PP). Specifications for pipes, fittings and the system
- 34 BS EN 1561 - Founding. Grey cast irons
- 35 BS EN 1562 - Founding - malleable cast iron fittings
- 36 BS EN 1563 - Founding. Spheroidal graphite cast iron
- 37 BS EN 1567 - Building valves. Water pressure reducing valves and combination water reducing valves. Requirements and tests
- 38 BS EN 1982 - Copper and copper alloys. Ingots and castings
- 39 BS EN 10088-1: Stainless steels. List of stainless steels
- 40 BS EN 10213 – Steel castings for pressure purposes

- 41 BS EN 10216-1 - Seamless steel tubes for pressure purposes. Technical delivery conditions
 - 42 BS EN 10217-1 - Welded steel tubes for pressure purposes. Technical delivery conditions. Non-alloy steel tubes with specified room temperature properties
 - 43 BS EN 10255 - Non-alloy steel tubes suitable for welding and threading. Technical delivery conditions
 - 44 BS EN 10272 - stainless steel bars for pressure purposes
 - 45 BS EN 12164 - Copper and copper alloys. Rod for free machining purposes
 - 46 BSEN 12165: Copper and Copper alloys. Wrought and unwrought forging stock
 - 47 BS EN 12167 - Copper and copper alloys. Profiles and rectangular bar for general purposes
 - 48 BS EN 12266-1 - Industrial valves. Testing of valves. Pressure tests, test procedures and acceptance criteria. Mandatory requirements
 - 49 BS EN 12266-2 - Industrial valves. Testing of valves. Tests, test procedures and acceptance criteria. Supplementary requirements
 - 50 BS EN 12288 - Industrial valves. Copper alloy gate valves
 - 51 BS EN 12334 - Industrial valves. Cast iron check valves
 - 52 BS EN 12729 - Devices to prevent pollution by backflow of potable water. Controllable backflow preventer with reduced pressure zone. Family B. Type A
 - 53 BS EN 13190 - Dial thermometers
 - 54 BS EN 13709 - Industrial valves. Steel globe and globe stop and check valves
 - 55 BS EN 13789 - Industrial valves. Cast iron globe valves
 - 56 BS EN 13828 - Building valves. Manually operated copper alloy and stainless steel ball valves for potable water supply in buildings. Tests and requirements
 - 57 BS EN 13959 - Anti-pollution check valves. DN 6 to DN 250 inclusive Family E, type A, B, C, and D
 - 58 BS EN ISO 228-1: Pipe threads where pressure tight joints are not made on the threads. Dimensions tolerances and designation
 - 59 BS EN ISO 1452 - Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized polyvinylchloride (PVC-U)
 - 60 BS EN ISO 17292 - Metal ball valves for the petroleum, petrochemical and allied industries.
- B Fittings installed in domestic water services pipework must be included in the WRAS "Water Fittings and Materials Directory" and satisfy the requirements of the Regulations.
- C Grooved end valves shall be of the same manufacturer as the adjoining couplings.
- D Pipework support systems shall be supported from the building structure, generally conforming with the following and where specified elsewhere:
- 1 Standard Detail drawings
 - 2 Manufacturers' recommendations in respect of plastic pipe
 - 3 BS EN 13480
 - 4 B &ES (formerly HVCA) technical guidance:
 - a TR20 Installation and Testing of Pipework systems
 - b TR/20/1 Low Temperature Hot water heating
 - c TR20/2 Medium Temperature Hot Water Heating
 - d TR20/3 High Temperature Hot water
 - e TR20/4 Hot Water Services
 - f TR20/5 Cold water
 - g TR20/6 Chilled Water
 - h TR20/7 Condenser water
 - i TR20/8 Steam and Condensate
 - j TR20/9 Natural Gas
 - k TR20/10 Fuel Oil.
 - 5 EJMA Standards by the Expansion Joint Manufacturers Association.

Y11.1.7 CO-ORDINATION

- A Co-ordinate layout and installation of pipework with other services, HVAC equipment, and architectural elements and partition assemblies.

Y11.2 PART 2 – PRODUCTS

Y11.2.1 GENERAL

- A Refer to valve type clauses and tables Y11.1 & 2 for valve applications.
- B Valve pressure and temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C Valve sizes: Same as upstream piping unless otherwise indicated.
- D Valve actuator types:
 - 1 Handwheel: For valves other than quarter-turn types
 - 2 Handlever: For quarter-turn valves DN 150 and smaller
- E Valves in insulated piping: With 50-mm stem extensions and the following features:
 - 1 Ball valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapour seal or disturbing insulation
- F Valve-end connections:
 - 1 Threaded: With threads according to BS EN 10226.
- G Ball type isolation valves may be used for connections to terminal units in sizes DN15-DN20. For other locations use gate valves. Where copper connections are permitted use copper alloy valves.

Y11.2.2 VALVES AND COCKS

- A Use valves accredited to the BSI Kitemark scheme where available or ensure that valves are manufactured under an approved ISO 9000 quality system. Valves shall be as far as it is practicable of the same manufacture and style to provide conformity of appearance and to simplify maintenance.
- B No asbestos containing materials shall be employed in any valves.
- C When the contract is complete, two sets of all manufacturers' keys are to be left with maintenance staff to enable all key operated valves to function.
- D Lock-shield valves shall have easy-clean shields or enclosures to match the inlet valves; two loose spindle keys shall be provided for each size of spindle.
- E Where grooved couplings are utilised on a system, as allowed by Section Y10, grooved end butterfly valves shall be used in lieu of flanged, lug, or wafer butterfly valves, flanged plug valves, or flanged gate valves in applicable sizes. Valves shall be from same manufacturer as the couplings.

Y11.2.3 VALVE SCHEDULE

- A Provide valves from one of the following manufacturers:
 - 1 Hattersley
 - 2 Crane Fluid Systems
 - 3 Pegler Yorkshire
- B Provide valves and ancillaries as the following table and to the standards specified in the following clauses.
- C Ensure valves and ancillaries are suitable for the maximum working pressures and temperatures.

Table Y11.1 Mechanical Services Pipework Schedule

Y11.2.4 TYPE BV2 – DZR BRASS ISOLATION BALL VALVE

- A Application: For isolation (IV) and flow regulation (LSV) purposes in domestic water and irrigation services in pipework sizes up to 54mm and pressures/temperatures as noted. May also be used for chilled water and heating services up to 100°C. For other temperature/pressure conditions use gate valves. Refer also to Table Y11.1:
- 1 Quarter turn lever: for most general isolation valve applications
 - 2 Extended stem lever: where required to extend beyond thermal insulation (e.g. for chilled water)
 - 3 T handle: where space is restricted
 - 4 Screwdriver operated: Where exposed to view at sanitary ware
 - 5 Lockshield: Where required for flow regulation.
- B Manufacturers:
- 1 Hattersley: Fig100C
 - 2 Crane FS: D171A
 - 3 Pegler: PB550
- C Design conditions:
- 1 Max Temperature: 100°C
 - 2 Maximum pressure: 6.9 bar.
- D Description: Full bore bronze or DZR brass body ball valve with chrome-plated brass ball and quarter turn lever:
- 1 Sizes: screwed 15 to 54mm
 - 2 Ends:
 - a Compression
 - b Screw threaded with O ring seal – BS EN 10226-2.
 - 3 Standard:
 - a Water services: BS EN 1254-2
 - b Gas services: BS EN 331+A1.
 - 4 Approvals: WRAS for water services.
- E Construction:
- 1 Body: DZR Brass
 - 2 Seats: PTFE
 - 3 Ball: DZR Chrome Plated
 - 4 Lever: Steel Plated.
- F Flow restrictor insert: Where noted on drawings, provide combined isolation / flow regulation for sanitary fittings. Flow regulator insert with access port on side of valve to allow removal of flow regulator cartridge without draining down system. Cartridges to be selected to match draw off rates provided in BS EN 802-3.

Y11.2.5 TYPE GV3 – BRONZE GATE VALVES

- A Application: For Isolation (IV) purposes in domestic hot, cold and irrigation water services in pipework sizes up to 54mm and Group 2 liquids as defined by PED 97/23/EC. Refer also to Table Y11.1.
- B Manufacturers:
- 1 Hattersley: 30C
 - 2 Crane FS: D151
 - 3 Pegler: GM63
- C Design conditions:
- 1 Max Temperature: 100°C
 - 2 Maximum Pressure: 6.9 bar.

D Description: One-piece wedge, non-rising DZR brass stem gate valve, and handwheel:

- 1 Sizes: screwed 15 to 54mm
- 2 Ends:
 - a Compression BS EN 1057+A1.
- 3 Standards: BS EN 12288 PN 16 series B
- 4 Approvals: Kitemarked, WRAS.

E Construction:

- 1 Body: Bronze (BS EN 1982)
- 2 Disc: Bronze
- 3 Gland: Brass
- 4 Stem DZR Brass (BS EN 12164)
- 5 Handwheel: Aluminium/malleable iron.

F Provide metal hand wheel unless noted as a lock-shield type.

Y11.2.6 TYPE CS-1 COMMISSIONING SETS

A Application: Commissioning sets (CS) providing combined, isolation, flow regulation and flow measurement. For use in chilled water, LTHW, MTHW, Condenser Water and domestic water services in pipework sizes 15 to 50mm. Refer also to Table Y11.1.

B Manufacturers:

- 1 Hattersley: Select valve according to flow rate information provided by manufacturer
 - a Standard flow: 1732
 - b Medium flow: 1732M
 - c Low flow: 1732L.
- 2 Pegler: 900XS

C Design conditions:

- 1 Threaded ends: (BS 7350 PN20):
 - a 20 bar from -10 to 100°C
 - b Maximum 17.2 bar at 120°C.
- 2 Compression ends:
 - a 6 bar at 110°C
 - b 16 bar from -10 to 30°C.

D Description: Inside screw non-rising stem, fixed orifice double regulating valve (FODRV) with integral orifice, test points and numerical indicator:

- 1 Sizes: 15 to 50mm
- 2 Ends:
 - a 25 to 50mm: Taper threaded; BS EN 10266
 - b 15 to 22mm: Parallel threaded to ISO 228
 - c Compression.
- 3 Standards: BS 7350
- 4 Approvals: Kitemarked, WRAS approved.

E Construction:

- 1 Body: Bronze (BS EN 1982)
- 2 Stem: DZR copper alloy
- 3 Stem seals: EPDM
- 4 Disc: DZR copper alloy (BS EN 12165)
- 5 Test Valve: DZR.

Y11.2.7 TYPE NRV5 DOUBLE CHECK

- A 15-28mm: Double check valve to BS EN 13959 in dezincification resistant copper alloy with test point. Compression ends to BS EN 1254-2. WRAS Approved for Category 3 backflow protection.
- B Manufacturers:
- 1 Hattersley Fig 249, or equal and approved
 - 2 Pegler: K4426.

Y11.2.8 TYPE NRV6 DOUBLE CHECK

- A 50-250mm: Double check valve to BS EN 13959. Flanged to BS EN 1092 PN16. WRAS Approved for Category 3 backflow protection. Body in ductile iron to BS EN 1563 with nitrile seat and stainless-steel spring.
- B Manufacturers:
- 1 Hattersley Fig 2761 or equal and approved.

Y11.2.9 TYPE - RPZ VALVES

- A 15-108mm: Reduced-Pressure-Principle (RPZ) Backflow Preventers to BS EN 12729. WRAS Approved for Category 4 backflow protection. Body in DZR or bronze. Accessories: Isolation valves. Strainer installed immediately upstream, Type AA air gap tundish installed below valve.
- B Manufacturers:
- 1 Crane FS Fig 255.

Y11.2.10 TYPE PRV1 - PRESSURE REDUCING VALVES

- A Application: For pressure control on domestic hot and cold potable and non-potable water services in sizes pipework up to 50mm.
- B Manufacturers:
- 1 Reliance: PRED 315
 - 2 Johnson: 536
 - 3 Crane FS
- C Design conditions:
- 1 Max temperature/pressure: 70°C/25 bar
 - 2 Adjustable set pressure 1.5 to 6.0 bar.
- D Description: A valve which reduces pressure from high inlet to low outlet under flow and no flow conditions. Downstream pressure controlled by a balanced spring and diaphragm. Body protected from debris by an internal stainless-steel strainer. Diaphragm separates the water supply from the control spring and associated mechanism. All working components contained in cartridge form with two downstream test points and clear pressure indicator on the side of the cartridge:
- 1 Sizes: Screwed 15 to 54mm
 - 2 Ends:
 - a Taper threaded BS EN 10226 (ISO 7-1).
 - 3 Standards: BS EN 1567
 - 4 Approvals: Kitemarked, WRAS
 - 5 Control: to within 35mbar of the design set pressure.
- E Construction:
- 1 Body: DZR Brass

- 2 Seals: EPDM
- 3 Diaphragm: EPDM
- 4 Strainer: Stainless Steel
- 5 Cover: ABS.

- F Where apparatus on the low-pressure side is capable of withstanding the maximum pressure of the high pressure line, valves may be of the single-seated spring-loaded diaphragm type.
- G Valves shall be adjustable within the specified low-pressure range and shall be installed with a safety or relief valve in the low-pressure side.

Y11.2.11 DRAIN COCKS

- A Application: Provide at all system low points and in plantrooms on major plant. Enables system to be drained down and prevents build-up of sediment. Designed for hose attachment.
- B Description: Hose union pattern gland cock in bronze to BS EN 1982. Threaded to BS 21 complete with captive cap:
- C Manufacturers:
- 1 Hattersley: 371
 - 2 Crane FS: D340:
 - 3 Pegler: 833GM, 833GMLS.
- D Sizes: 15 to 25mm:
- 1 10 bar at 110°C
 - 2 Body: Bronze: BS EN 1982
 - 3 Stem: Brass
 - 4 Bonnet: Brass BS EN 12164
 - 5 Ends: BSP parallel thread.

Y11.3 PART 3 - EXECUTION

Y11.3.1 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A Comply with the valve applications indicated in table Y11.1.
- B If valve applications are not indicated in table Y11.1, use the following:
- 1 Shutoff service: Ball, butterfly, or gate valves
 - 2 Butterfly valve dead-end service: Single-flange (lug) type
 - 3 Throttling service except steam: Globe or butterfly valves
 - 4 Throttling service, steam: Globe valves
 - 5 Pump-discharge check valves
 - 6 DN 50 and smaller: Bronze swing check valves with bronze disc
 - 7 DN 65 and larger: Iron swing check valves with lever and weight or with spring or iron, centre-guided, resilient-seat check valves.
- C If valves with specified PN class or pressure ratings are not available, the same types of valves with higher PN ratings or pressure ratings may be substituted.
- D Select valves, except wafer types, with the following end connections:
- 1 For copper tubing, DN 50 and smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules
 - 2 For copper tubing, DN 65 to DN 100: Flanged ends except where threaded valve-end option is indicated in valve schedules
 - 3 For copper tubing, DN 125 and larger: Flanged ends
 - 4 For steel piping, DN 50 and smaller: Threaded ends
 - 5 For steel piping, DN 65 to DN 100: Flanged ends except where threaded valve-end option is indicated in valve schedules
 - 6 For steel piping, DN 125 and larger: Flanged ends
 - 7 For grooved-end steel piping except steam and steam condensate piping: Valve ends may be grooved.
- E Ensure that all balancing and flow regulation valves are correctly selected and installed to suit the flow rates indicated in the specification and drawings. The position of all regulating / balancing valves must be approved by the commissioning engineer prior to installation.
- F Regulation and balancing of the systems shall be achieved by the installation of commissioning stations and isolating valves. A commissioning station shall be provided on the return branch or sub-circuit return main and an isolating valve shall be provided on the corresponding flow connection, flow branch or sub-circuit flow main. The commissioning station shall consist of a double regulating valve and metering station as detailed elsewhere.
- G The commissioning stations shall be installed to the manufacturer's recommendations, with special regard to straight pipe lengths required before and after the assembly.
- H A regulating valve shall be provided on the return pipe from each terminal unit and an isolating valve shall be provided on the corresponding flow connection to each terminal unit.

Y11.3.2 EXAMINATION

- A Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C Examine threads on valve and mating pipe for form and cleanliness.

- D Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E Do not attempt to repair defective valves; replace with new valves.

Y11.3.3 VALVE INSTALLATION

- A Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B Locate valves for easy access and provide separate support where necessary.
- C Install valves in horizontal piping with stem at or above centre of pipe.
- D Install valves in position to allow full stem movement.
- E Install chainwheels on operators for butterfly valves DN 100) and larger and more than 2400 mm) above floor. Extend chains to 1520 mm above finished floor.
- F Install check valves for proper direction of flow and as follows:
 - 1 Swing check valves: In horizontal position with hinge pin level
 - 2 Plate-type check valves: In horizontal or vertical position, between flanges.
- G Grooved end valves shall be installed in accordance with the manufacturer's latest published installation instructions on applicable piping systems:
 - a Factory trained field representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products
 - b The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or jobsite visit(s)).

Y11.3.4 ADJUSTING

- A Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

Y11.3.5 PRESSURE REDUCING VALVES

- A Install PRVs with an isolating valve and strainer on the inlet and a pressure gauge on the downstream side. Pressure gauges to be mounted on mild steel siphons with bronze isolating cocks.
- B Ensure valves are suitable for the maximum and minimum operating conditions.

Y30 THERMAL INSULATION

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Y30.1 PART 1 – GENERAL

- A This section covers the requirements and supply, application and installation, of internal and external thermal insulation of pipework, ductwork, vessels and auxiliary equipment.
- B This section covers fire stopping materials for service penetrations through fire compartmented walls, floors, ceilings and roofs and where indicated on the drawings.
- C This section also covers the requirements for electric trace heating for freeze prevention, domestic hot water maintenance, snow and ice melting on roofs and gutters.

Y30.1.2 RELATED DOCUMENTS

- A For drawings and general provisions of the contract, including main contract preliminaries refer to 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 Related sections include the following:
 - 1 Hot and Cold-water supply S10
 - 2 Ductwork Systems U80
 - 3 Pipelines: Y10, Y11
 - 4 Mechanical Plant and equipment identification Y32
 - 5 Testing and commissioning. Y50
 - 6 Fixing to building Fabric Y90.

Y30.1.3 SUMMARY

- A Section includes thermal insulation for the following duct services:
 - 1 Extract ducts (normally un-insulated but see exceptions)
- B This section includes the provisions for electric trace heating to prevent freezing and for temperature maintenance of domestic hot water systems.

Y30.1.4 DEFINITIONS

- A Insulation in hot service is defined as vessels, equipment, piping and ancillaries at normal operating temperatures above ambient temperature where reduction in heat loss from the transported fluid is desired:
 - 1 Domestic hot water (DHW): up to 65°C
- B Insulation in cold service is defined as vessels, equipment, piping and ancillaries at normal operating temperature of +15°C and lower where a reduction of heat gain into the transporting fluid and the prevention of surface condensation is desired:
 - 1 Cold water (CW): 10°C to 15°C (note this includes mains water services)
- C Warm air ducts are defined as supply or return air ducts in which the air inside the duct is always above ambient temperature. These ducts are insulated in a different manner from air conditioning ducts.
- D Air conditioning ducts are defined as supply or return air ductwork in projects where the supply air may be cooled or dehumidified.

Y30.1.5 PERFORMANCE REQUIREMENTS

- A Provide thermal insulation for the following purposes:
- 1 To protect personnel from hazard due to hot or cold surfaces:
 - a Non-metallic surface: 59°C max
 - b Metallic surface: 55°C max
 - c Surfaces at higher levels within reach of ladder: 50°C
 - d Cold surfaces: -10°C min.
 - 2 To limit heat loss when transporting hot fluids
 - 3 To guard against heat uptake when transporting cold fluids
 - 4 To prevent condensation forming on pipework or ductwork or equipment
- B For ductwork installations the following ducts must be insulated to the applicable standards:
- 1 Extract air - Not normally insulated unless being used to conduct air used for return or heat recovery purposes. Insulation is required in unheated plantrooms and externally where there is a risk of internal condensation forming. In these situations, insulate as air conditioning ducts
 - 2 Ensure ancillary components such as attenuators are provided with insulation where forming a part of one of the systems above.
- C All materials shall be strictly in accordance with this specification. Ensure values are insulated in accordance with BS EN 12664, BS EN 12667, BS EN 12939 or BS EN ISO 8990.
- D Insulation materials and including finishes, throughout the operating temperature range and internal conditions shall be:
- 1 Of weatherproof quality for outdoor situations
 - 2 Of sufficient strength if liable to mechanical damage or foot traffic
 - 3 Resistant to vermin attack
 - 4 Resistant to the growth of fungi
 - 5 Protected, manufactured and installed to prevent electrolytic action corrosion or decay.
- E Constraints: Comply with the following constraints unless specifically indicated otherwise in section B of this specification.
- 1 Mineral wool: Do not use mineral wool or fibrous materials in the following applications (including ceiling voids and ducts, and access from these areas):
 - a Hospital operating theatres or aseptic spaces
 - b Pharmaceutical industries
 - c Electronic equipment manufacture
 - d Computer rooms
 - e Food preparation areas
 - f On chilled water or cold-water pipework
 - g Any areas which could be sensitive to fibre contamination
 - h On ductwork, where the in-duct temperature is lower than the ambient surrounding temperature.
 - 2 Phenolic foam: Do not use phenolic foam for the following applications:
 - a Where applied to surfaces operating above 100°C
 - 3 Calcium silicate: Do not use in the following applications:
 - a Chilled or cold-water pipework
 - b Air conditioning ducts which operate below ambient temperature.
 - 4 Stainless Steel Corrosion barriers: A corrosion barrier is not required for stainless steel pipes and vessels, which are not being exposed to moisture (e.g. in internal, warm and dry conditions). If, however, the thermal insulation is likely to become moist (ie on external pipework, chilled water, or cold-water services), prior to application of the thermal insulation, apply a corrosion barrier the pipe or vessel. Two types of corrosion barrier are used in conjunction with insulation manufactured with a waterproof finish: a suitable paint (e.g. a high temperature silicone type) or 0.06 mm thick aluminium foil. In practice, the use of aluminium foil is favoured because of ease of application. Such corrosion barriers should be

applied in accordance with BS 5970 - Code of practice for thermal insulation of pipework and equipment.

- F All thermal insulation work shall comply with the requirements of the approved standards and codes.
- G Unless otherwise indicated, all thermal insulating materials used shall have a European fire classification of B/B_L-s3, d2 or better in accordance with BS EN 13501-1. Thermal insulating materials used shall be free from substances, which in the event of a fire would generate appreciable quantities of smoke, noxious or toxic fumes. When requested by the CA, provide evidence of fire classification, obtained from an approved testing laboratory, in order to certify that materials comply with this clause.
- H On internally situated insulation, all finishes applied to insulation shall conform to Building Regulations Class O.
- I On internally situated insulation, adhesives and sealants bonded to the insulation shall achieve a minimum BS 476-7 Class 1 rating.
- J Insulation materials will have a Global Warming Potential (GWP) less than five. Insulation materials to be manufactured from materials having an Ozone Depletion Potential (ODP) of zero.

Y30.1.6 SELECTION OF INSULATING MATERIAL

- A Select the appropriate insulating material and protection as indicated. Ensure that the selected material and finish is suitable for the operating environment.
- B Use only those materials and options indicated. Seek written permission from the CA to use any other alternative.
- C Table 1 indicates acceptable options for the application of thermal insulating materials and protective finishes to building services pipework and ductwork. Comply with the requirements indicated in section B of this specification which may identify particular options to be used on the project:
 - 1 This table indicates suitable materials for normal applications in the UK. Where products are to be applied in more onerous locations seek advice for the appropriate materials and insulation thickness
 - 2 Should the insulation be installed in coastal or highly polluted environments use the alternative external cladding indicated for this environment
 - 3 For damp internal environments use specification for external locations
 - 4 The following codes are used in the table below
 - 5 Approved insulation materials for each application:
 - 1 - phenolic foam 35 kg/m³
 - 2 - mineral wool pipe sections 120 kg/m³

6 Approved covering specification for each application:

- A - Class O aluminium foil (factory applied)
- B - Aluminium sheet
- C - Multi-layered aluminium foil and polyester sheet
- D - Multi-layered polyester/aluminium/polymer sheet
- E - Aluzinc coated sheet steel
- F - Aluminium Sheet applied under multi-layered aluminium foil/polyester sheet
- G - Manufacturer's brush applied weather protective coating
- H - Un-faced

Table 1 – Thermal Insulating Material and Finishes Selection			
Service to be insulated	Location of service	Insulation Material	Covering material
DHW	Roof voids	1 or 2	A
	Ceiling/floor voids	1	A
	Exposed to view or	1	A
	Exposed to view (alternative)	1	A + B or A + C or A+D
	Plantrooms	1 or 2	A + B
	External (normal environment)	1 or 2	A + B
	External (coastal or aggressive environments)	1 or 2	A + E or A+F+C or A+D
CWS	Roof voids	1	A
	Ceiling/floor voids	1	A
	Exposed to view or	1	A
	Exposed to view (alternative)	1	A + B or A + C or A+D
	Plantrooms	1	A + B
	External (normal environment)	1	A + B
	External (coastal or aggressive environments)	1	A+E or A+F+C or A+D
Note: Cladding types C&D can additionally be used in plantrooms where special approval is given from the CA due to the reduced mechanical strength compared to alternative specified.			

Y30.1.7 INSULATION THICKNESSES

A Ensure that the thermal insulation thickness complies with the following:

- 1 Building Regulations Approved Document Part L2A
- 2 Non- domestic Building Services Compliance Guide
- 3 TIMSA HVCA Guide section 6.2.1,6.2.2
- 4 BS 5422; Tables 15 to 18
- 5 Enhanced Capital allowance Energy Technology list

B Where the values differ take the larger thickness. Tables 2-5 are to control against excessive heat loss or heat gain, to ensure surface temperatures are not above 59°C and to avoid condensation on cold and chilled services. Tables 6-7 indicate minimum insulation thickness to give protection against freezing. For material properties refer to Part 2 of this section.

- C These tables are based on summertime ambient conditions which do not exceed 25°C/80% rh. For summertime ambient air temperatures and humidity outside of the above standard conditions the thickness of insulation should be increased by calculation according to BS EN ISO 12241 and a secondary brush applied vapour barrier coating will be required for all cold services.
- D For phenolic foam comply with the following minimum thickness relating to each of the services and operating temperature conditions indicated.

Table 2 - Minimum Thickness (mm) of Phenolic Foam Insulation.						
Nominal Pipe size (mm) (Steel)	Nominal pipe size (mm) (copper)	LTHW Up to 95°C mm	DHWS Up to 60°C mm	CWS Up to 10°C mm	Chilled Water 5 to +9°C mm	Chilled Water 0 to +4°C mm
15	15	15	15	15	20	25
20	22	20 (15 Cu)	15	15	20	25
25	28	20	20	20 (15 Cu)	25 (20 Cu)	30
32	35	20	20	20	25	30
40	42	25 (20Cu)	20	20	25	30
50	54	25	20	20	25	35
65	67	25	25	20	30	35
80	76	25	25	20	30	35
100	108	30 (25 Cu)	30(25 Cu)	25	35 (30 Cu)	40
125	133	30	30	25	35	45
150	159	30	30	25	35	45
200		30	30	30	40	50
250		35	35	30	40	50
Above 250 & including flat surfaces		35	35	30	40	50

- E For mineral wool insulation comply with the following minimum thickness relating to each of the services and operating temperatures indicated.

Table 3 - Minimum Thickness (mm) of Mineral Wool Insulation					
Pipe size (mm) Steel	Pipe size (mm) Copper	HTHW & steam 120-150°C mm	MTHW 96 to 120°C mm	LTHW Up to 95°C mm	DHWS+Fuel Oil Up to 70°C mm
15	15	30	25	25	25
20	22	30	30	25	25
25	28	40	35	35	30
32	35	40	35	35	30
40	42	40	40	35	30
50	54	45	40	40	35
65	67	50	45	40	35
80	76	50	45	40	35
100	108	50	50	45	40

Table 3 - Minimum Thickness (mm) of Mineral Wool Insulation					
Pipe size (mm) Steel	Pipe size (mm) Copper	HTHW & steam 120-150°C mm	MTHW 96 to 120°C mm	LTHW Up to 95°C mm	DHWS+Fuel Oil Up to 70°C mm
125	133	50	50	45	40
150	159	60	50	50	40
200		60	50	50	40
250		60	60	50	40
Above 250 & including flat surfaces		60	60	50	40

Y30.1.8 SUBMITTALS

- A Product data: For each type of product indicated provide a sample and details. Include thermal conductivity, water-vapour resistance, thickness, and jackets (both factory and field applied if any):
 - 1 Pipework insulation
 - 2 Ductwork insulation
 - 3 Chilled water and hot water valves insulation
- B For adhesives and sealants, provide documentation including printed statement of VOC content and chemical components and COSH details sheet.
- C For trace heating include rated capacities, operating characteristics and components for each type of product.
- D Shop drawings:
 - 1 Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger
 - 2 Detail attachment and covering of heat tracing inside insulation
 - 3 Detail insulation application at pipe expansion joints for each type of insulation
 - 4 Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation
 - 5 Detail removable insulation at piping specialties
 - 6 Detail application of field-applied jackets
 - 7 Detail application at linkages of control devices
 - 8 Wiring diagrams for trace heating.
- E Qualification data: For qualified Installer membership of Thermal Insulation Contractor's Association.
- F Material test reports: From a qualified testing agency, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- G Field quality-control reports.

Y30.1.9 QUALITY ASSURANCE

- A Employ a specialist thermal insulation subcontractor to carry out all thermal insulation work. Ensure that firm is a member of the Thermal Insulation Contractors Association.
- 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 will be exposed.
- C Ensure that the whole installation complies or is tested to the relevant standards, including the following:

- 1 BS 476-6 +A1- Fire tests on building materials and structures Method of test for fire propagation for products
- 2 BS 476-7 - Fire tests on building materials and structures Method of test to determine classification of surface spread of flame of products
- 3 BS 3533 - Glossary of thermal insulation terms
- 4 BS 3958-2 - Thermal insulation materials. Calcium Silicate preformed insulation: *(But note that whilst the Calcium silicate standard is listed as current by the BSI, all product declarations for CS have to be in accordance with BS EN 14306 for the purposes of CE Marking. Compliance with BS 3958 does not indicate compliance with current UK law)*
- 5 BS 3958-3 - Thermal insulation materials. Metal mesh faced man-made mineral fibre mattresses
- 6 BS 3958-4 - Thermal insulation materials. Bonded preformed manmade mineral fibre pipe sections
- 7 BS 3958-5 - Thermal insulating materials Specification for bonded man-made mineral fibre slabs: *(But note that whilst the Mineral wool standards are listed as current by the BSI, all product declarations for MW have to be in accordance with BS EN 14303 for the purposes of CE Marking. Compliance with BS 3958 does not indicate compliance with current UK law)*
- 8 BS 3958-6 Thermal insulating materials. Finishing materials; hard setting composition, self-setting cement and gypsum plaster
- 9 BS 5422 - Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C
- 10 BS 5970 - Thermal insulation of pipework, ductwork, associated equipment and other industrial installations in the temperature range of – 100- 870 degrees centigrade. Code of practice
- 11 BS EN 12086: Thermal insulating products for building applications. Determination of water vapour transmission properties
- 12 BS EN 12939 - Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Thick products of high and medium thermal resistance
- 13 BS EN 12664 - Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Dry and moist products of medium and low thermal resistance
- 14 BS EN 12667 - Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Products of high and medium thermal resistance
- 15 BS EN 13501-1 + A1: Fire classification of construction products and building elements. Classification using test data from reaction to fire tests
- 16 BS EN 14303: Thermal insulation products for building equipment and industrial installations. Factory made mineral wool (MW) products. Specification
- 17 BS EN 14304: Thermal insulation products for building equipment and industrial installations. Factory made flexible elastomeric foam (FEF) products. Specification
- 18 BS EN 14306: Thermal insulation products for building equipment and industrial installations. Factory made calcium silicate (CS) products. Specification
- 19 BS EN 14314 +A1: Thermal Insulation products for building equipment and industrial installations. Factory made phenolic Foam (FM) products. Specification
- 20 BS EN ISO 4589-2 - Plastics. Determination of burning behaviour by oxygen index. Ambient-temperature test
- 21 BS EN ISO 4589-3: Plastics. Determination of burning behaviour by oxygen index. Elevated temperature test
- 22 BS EN ISO 5659-2 - Plastics. Smoke generation. Determination of optical density by a single-chamber test
- 23 BS EN ISO 8990 - Thermal insulation. Determination of steady-state thermal transmission properties. Calibrated and guarded hot box

- 24 BS EN ISO 12241 - Thermal insulation for building equipment and industrial Installations. Calculation rules
- 25 TIMSA HVAC Guide for achieving compliance with Part L of the building regulations.
- 26 UK Navel Engineering Standard 713.
- 27 Non-domestic Building Services Compliance Guide, Approved Document Part L associated document

- D The quality management system of all manufacturers of thermal insulation materials shall have been assessed and registered as meeting the requirements of ISO 9001. The scope of registration shall cover both manufacturing and distribution of insulation materials to the HVAC industry.

Y30.1.10 CO-ORDINATION

- A Co-ordinate sizes and locations of supports, hangers, and insulation shields specified in Y10 section relating to hangers and supports for HVAC piping and equipment.
- B Coordinate sizes and locations of supports, hangers, and insulation shields specified in U80 section relating to hangers and supports for HVAC ducting and equipment.
- C Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork shop drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- D Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping shop drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- E Coordinate installation and testing of heat tracing.

Y30.2 PART 2 – PRODUCTS

- A Do not use any products which use CFCs, HFCs or HCFCs in their manufacture.
- B For permitted types of thermal insulation refer to Table 1. Note:
- 1 Any pipework service (apart from refrigerant pipework) which operates below ambient temperature is to be insulated as for chilled water pipework
 - 2 Any ductwork service including fresh air and exhaust air which operates at temperatures below ambient temperature is to be insulated as for air conditioning ductwork
 - 3 Extract air in which the air inside the duct is above ambient and which is not part of a heat recovery system does not require to be insulated.
 - 4 Extract air which is used for heat recovery must be insulated when passing through areas which could adversely affect the efficiency of the heat recovery system.
- C When extracting insulation thickness from the tables the greater thickness shall be used when results fall between columns.
- D Ensure insulation material is suitable for application to the service material to which it is being applied.

Y30.2.2 VAPOUR BARRIERS

- A Provide a factory applied primary vapour barrier to all thermal insulation, on air conditioning ducts, chilled and cold water services and drainage systems where the services operate below ambient air temperature:
- 1 Internal pipework and ductwork: The primary vapour barrier comprising a factory applied fibre glass reinforced Class O aluminium foil, 18 microns thick, incorporating a 5mm × 5mm scrim pattern, with a burst strength of 400 kN/m². The water permeance of the foil shall be 0.001 g/ (sMN). All joints overlapped and continuously vapour sealed with a brush applied vapour mastic
 - 2 External and humid areas pipework and ductwork: For external locations, plantrooms subject to high humidity (greater than 80%RH), or where exposed to view in areas of high humidity provide vapour barrier as indicated above for internal services but the whole then to be clad with two full applications of a brush or spray applied vapour barrier mastic coating with an open weave no 10 glass cloth between coats and then finally clad in protective cladding material specified for that location.
- B Vapour barrier mastic coating: Sprayable or brush applied vapour barrier coating comprising a polymer emulsion, solvent free, to provide a durable and flexible water-resistant finish over a wide service temperature range. Apply a minimum of 2 coats in accordance with manufacturer's instructions.
- 1 Form: Thixotropic liquid
 - 2 Composition: Co-polymer emulsion
 - 3 Service temperature: -29°C to + 82°C
 - 4 Fire resistant properties:
 - a BS 476 Part 7: Class 1
 - b Building Regulations: Class 0.
 - 5 Water Vapour Permeance: 0.034 g/s at 1mm thick.
- C Joint sealants: Ensure materials are compatible with the insulation materials, jackets and substrates.

Y30.2.3 INSERTS FOR INSULATED PIPEWORK AND DUCTWORK BRACKETS

- A Provide Insulated pipe and ductwork support inserts of the following types in order to maintain the insulation thickness at the support. Support bracket to encompass the pipe and the insulation insert. Inserts to be of the following types:
- 1 Service operating temperature < 100°C: use phenolic type
 - 2 Service operating temperature > 100°C: use calcium silicate type.

B Phenolic type: Proprietary made high density phenolic foam (with zero ODP) circular rings or flat sections, of equal thickness to the insulation, inserted between the bracket and pipe or duct. Incorporate a factory applied metal spreader plate and a Class O vapour barrier. The length of the insert shall extend outside the bracket by at least 15 mm each side. Where pipework expansion takes place on roller chairs, the insert shall extend the full expansion distance plus 15 mm and an outer galvanised sheet steel casing of suitable thickness shall be secured to the insert to prevent damage:

- 1 Application: For thermally insulated pipework and ductwork services operating below 100°C temperature
- 2 Material: High density rigid phenolic foam
- 3 Density: BS EN ISO 845:
 - a For pipes <50mm use 60 kg/m³
 - b For pipes $\geq 76 \leq 125$ mm use 80 kg/m³
 - c For pipes ≥ 150 mm use 120kg/m³.
- 4 Thermal Conductivity: BS EN 12667:
 - a 60 kg/m³: 0.031 W/mK
 - b 80kg/m³: 0.036 W/m K
 - c 120 kg/m³: 0.045 W/m K.
- 5 Compressive strength(perpendicular): BS EN 826
 - a 60 kg/m³: 170 kN/m²
 - b 80 kg/m³: 340 kN/m²
 - c 120 kg/m³: 800 kN/m².
- 6 Fire propagation: Index of performance (I) <12, sub index (i1) <6, BS 476-6+A1
- 7 Surface spread of flame: Class 1, BS 476-7
- 8 Building Regulations: Class 0 (Low Risk Scotland)
- 9 Fire performance: BS EN 13501-1+A1 – 1 Euroclass BL-s1-d0.
- 10 Horizontal burning characteristics: ≤ 10 mm, BS EN ISO 3582.

C Calcium silicate type: A granular insulation made of lime and silica reinforced with inorganic fibres and moulded into flat sheets and pipe sections.

- 1 Application: For thermally insulated pipework services operating above 100°C temperature
- 2 Material: Low and high density calcium silicate
- 3 Density: BS EN ISO 845:
 - a For pipes <100mm use low density 260 kg/m³
 - b For pipes > 100mm use high density 770 kg/m³.
- 4 Thermal conductivity: BS EN 12667:
 - a 260 kg/m³: 0.058 W/m K
 - b 770 kg/m³: 0.18 W/m K.
- 5 Compressive strength: ASTM D 1621:
 - a 260 kg/m³: 1500 kN/m²
 - b 770 kg/m³: 11000 kN/m².
- 6 Fire performance: Non-combustible.

D Vapour barriers shall be continuous over the inserts and in the case of roller chairs, under the outer galvanised sheet casing.

Y30.2.4 INSULATING CEMENTS

A To eliminate condensation forming under the insulating material apply insulating cement, to the same thickness as the adjoining pipework, around irregularly shaped items in cold or chilled water services including such items as:

- 1 Valve bodies
- 2 Test pockets
- 3 Drains

4 Strainers.

- B Complete the insulation with a brush applied vapour barrier mastic coating and cladding as specified elsewhere.
- C Mineral-fibre insulating cement: Blend of hydraulic cement, calcium silicate and inorganic mineral fibres and corrosion inhibitors, applied by trowel:
- 1 Standard: BS 3958 part 6.
 - 2 Compressive strength: 1379kPa
 - 3 Density: 320kg/m³
 - 4 Thermal conductivity: 0.115 W/m K
 - 5 Application: Strictly in accordance with manufacturer's instructions.

Y30.2.5 ELECTRIC TRACE HEATING

- A Frost protection cables type FPT 1&2: Application for frost protection on pipework operating at a maximum 65°C ambient temperature. Self-regulating heating element with 1.2mm² copper conductor, modified polyolefin insulation, protective tinned copper protective braid and modified polyolefin outer protective jacket. Use where indicated in Tables 9 &10:
- 1 Type FPT 1: Heat output - 10 W/m at 5°C
 - 2 Type FPT 2: Heat output – 26 W/m at 5°C.
- B Frost protection cables type FPT 3 and Hot water maintenance tape HWMMT 1: Application for frost protection on metal pipework operating at a maximum 95°C ambient temperature. Use also for temperature maintenance and for metal waste pipes carrying fatty waste. Self-regulating heating element with 1.2mm² copper conductor, modified polyolefin insulation, protective tinned copper protective braid and modified polyolefin outer protective jacket. Use where indicated in Tables 9 &10:
- 1 Type FPT 3: Heat output - 31 W/m at 5°C
 - 2 Type HWMT 1: Heat output – 22 W/m at 40°C.
- C Frost protection cables type FPT4: Application for frost protection on metal pipework operating at a maximum 90°C ambient temperature. Use for long circuit applications and for central heating pipework. Self-regulating heating element with 1.4mm² copper conductor, modified polyolefin insulation, protective tinned copper protective braid and modified polyolefin outer protective jacket. Use where indicated in tables 9 & 10:
- 1 Type FPT 4: Heat output - 10 W/m at 5°C.
- D Hot water maintenance cables HWMT 2 & 3: Application for maintenance of domestic hot water at a minimum temperature indicated for non-recirculating hot water systems (single pipe) for minimising legionella risk. Use where indicated in Tables 9 &10:
- 1 Type HWMT 2: heat output – 7 W/m at 45°C
 - 2 Type HWMT 3: heat output – 12 W/m at 70°C.

Y30.3 PART 3 - EXECUTION

Y30.3.1 EXAMINATION

- A Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application:
- 1 Verify that systems to be insulated have been tested and are free of defects
 - 2 Verify that surfaces to be insulated are clean and dry
 - 3 Proceed with installation only after unsatisfactory conditions have been corrected.
- B Insulation shall not be applied to pipes, plant and ductwork until such equipment has been inspected and successfully pressure tested:
- 1 Pre-installation inspection:
 - a Examine all areas of ductwork and pipework and correct any unsatisfactory condition detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner approved by the CA.
 - 2 Post-installation check:
 - a The CA should be advised three days in advance before the painting of any surface so that work may be inspected if required by the CA.
- C Only first class workmanship will be accepted.
- D Materials containing asbestos are not permitted.
- E Store materials delivered to site in a dry place until required for use.
- F Ensure pipe sections have the exact diameter of the pipe to be insulated and are delivered to the site in cartons or other packages clearly marked with the exact outside diameter for which they are suitable. Sections shall be formed with longitudinal splits for ease of installation.
- G Pipes and brackets shall be painted where appropriate before the application of insulation in accordance with the specification for 'painting' (refer to Y10).
- H Ensure that all pipes and ducts are individually insulated.
- I Dissimilar metals and materials subject to galvanic corrosion must not be installed in contact with each other.
- J The uses of galvanised or zinc coated insulation steel jacketing and accessories on or near austenitic stainless steel and austenitic nickel steel/alloy equipment and piping, is prohibited.

Y30.3.2 THERMAL INSULATION APPLICATION - GENERAL

- A Determine appropriate insulation material, vapour barrier and cladding, the thickness of insulation for pipework and ductwork services from the preceding tables.
- B All insulation materials shall be applied in accordance with the manufacturer's instructions, codes of practice and with this specification.
- C The insulation shall not be left exposed at termination points. Insulation edges shall be over taped and returned and adhered to the exposed insulation face. Care must be taken to ensure the aluminium foil does not come into direct contact with the insulated metal face.
- D If cold and damp conditions are anticipated during installation, use an aluminium foil tape with an acrylic adhesive.
- E Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and ducts and fittings.

- F Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- G Install insulation with longitudinal seams at top and bottom of horizontal runs.
- H Install multiple layers of insulation with longitudinal and end seams staggered.
- I Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- J Keep insulation materials dry during application and finishing.
- K Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- L Install insulation with least number of joints practical.
- M Where vapour barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapour-barrier mastic:
- 1 Install insulation and cladding continuously through hangers and around anchor attachments
 - 2 For insulation application where vapour barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapour-barrier mastic
 - 3 Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer
 - 4 Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- N Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- O Install insulation with factory-applied jackets as follows:
- 1 Draw jacket tight and smooth
 - 2 Cover circumferential joints with 75-mm wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 100 mm centres
 - 3 Overlap jacket longitudinal seams at least 38 mm. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 50 mm centres
 - a For below-ambient services, apply vapour-barrier mastic over staples.
 - 4 Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapour seal
 - 5 Where vapour barriers are indicated, apply vapour-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- P Cut insulation in a manner to avoid compressing insulation more than 75% of its nominal thickness.
- Q Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- R Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 100 mm beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- S For above-ambient temperature services, do not install insulation to the following:
- 1 Vibration-control devices
 - 2 Testing agency labels and stamps
 - 3 Nameplates and data plates
 - 4 Manholes
 - 5 Handholes
 - 6 Cleanouts.

Y30.3.3 PIPEWORK PREPARATION

- A Surface preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B Surface preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1 Stainless steel: Coat 300 series stainless steel with a painted finish in accordance with Y10. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range
 - 2 Carbon steel: Coat carbon steel operating at a service temperature between 0 and 149°C with an epoxy coating (refer to Y10). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range
 - 3 Copper pipework to be prepared in accordance with BS 5422 and Y10
 - 4 For thermal insulation of buried services comply with BS 4508.
- C Co-ordinate insulation installation with the installation of heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

Y30.3.4 PIPEWORK THERMAL INSULATION APPLICATION

- A Use insulation sections that are pre-formed to fit the diameter of the pipe or underneath layer of insulation.
- B Seal all circumferential and longitudinal seams in the aluminium foil laminate insulation jacket with 75mm wide aluminium pressure sensitive tape. Apply additional bands of foil tape circumferentially at not greater than 450mm centres, ensuring a minimum of three self-adhesive tape bands per cut section. Retain mineral wool and calcium silicate sections in position by light gauge aluminium bands at a maximum of 450mm spacing, and not nearer than 50mm to the end of the section.
- C Cut to fit mitre bends on site and seal all joints securely with 75mm wide aluminium foil tape.
- D Where pipe expansion is anticipated, detail expansion compensation for insulation on drawings and indicate intervals for its occurrence.

Y30.3.5 INSULATION OF PIPE FITTINGS, VALVES, STRAINERS, FLANGES, AND UNIONS:

- A Install insulation boxes over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapour-retarder integrity unless otherwise indicated. Insulation may be removable type or fixed type as indicated in part 2 of this specification section:
- B Insulate pipe elbows using preformed fitting insulation or mitred fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
- C Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
- D Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

- E Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapour barrier.
- F Insulate flanges and unions using a section of oversized preformed pipe insulation or flexible jackets (on hot services). Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
- G Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapour-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
- H Insulate instrument connections for thermometers, pressure gauges, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

Y30.3.6 VAPOUR BARRIERS

- A Provide a water vapour barrier where thermal insulation is applied to the outside of piped and ducted services, equipment and plant used to convey, store or generate fluids or gases at temperatures lower than the design ambient dew point temperatures indicated.
- B Apply the vapour barrier such that it is continuous and gives protection to the whole surface of the insulation which it protects. It shall not be pierced or otherwise damaged by supports or by the application of external cladding. Provide, at points of support, a means of load distribution.
- C For foil vapour barriers, seal the circumferential and longitudinal seams in the vapour barrier foil with an approved pressure sensitive, 75mm wide, 30 micron thick, and aluminium foil vapour barrier tape. There shall be absolutely no cracks, open joints or seams in the vapour barrier foil.
- D Apply adhesives mastics and sealants at manufacturer's recommended coverage rate and wet and dry film thickness.
- E Any evidence of discontinuity of the vapour barrier jacket will be sufficient cause for rejection or repair.

Y30.3.7 INSULATION OF COLD WATER, CHILLED WATER AND CONDENSER PIPEWORK

- A Take particular care to vapour seal insulation termination points on pipework, valves and equipment operating below ambient temperature in accordance with BS 5970.
- B A suitable vapour barrier sealant shall be applied to moisture proof the interface between the insulation foam and the underneath metal face at all termination points and the vapour barrier shall be returned effectively and sealed to the butt end of the insulation section so as not to allow any ingress of moisture or water vapour.
- C Particular care shall be taken to ensure neither water nor water vapour may enter the insulation system via valve spindles.

Y30.3.8 DUCTWORK THERMAL INSULATION APPLICATION - PNENOLIC FOAM

- A Only closed cell insulation, such as phenolic foam, to be used on air conditioning ductwork (supply or return). Use mineral wool only if permitted in Table 1.

1 Circular ductwork:

- a Fabricate from pipe insulation sections or lags pre-formed to fit the diameter of the duct, faced with Bright Class "O" aluminium foil
 - b Apply to the duct with a suitable adhesive
 - c Seal longitudinal and circumferential joints with self-adhesive aluminium foil tape of a minimum width of 100mm
 - d Secure all insulation sections or lags with a minimum of three self-adhesive tape bands per linear metre of ductwork
 - e If cold and damp conditions are anticipated during installation, consideration shall be given to utilising an aluminium foil tape with an acrylic adhesive
 - f Ensure vapour barrier is not damaged or punctured in anyway.
- 2 Flat oval ductwork:
- a Generally as for circular ductwork
 - b All flat insulation slabs shall be cut to fit on site. The insulation slabs shall be adhered to the duct with a suitable adhesive. On the underside of the duct the insulation shall be additionally secured by means of suitable insulation hangers, fixed at maximum 300mm centres.
- 3 Rectangular ductwork:
- a All insulation slabs shall be cut to fit on site. The top and bottom slabs shall overlap the sides at all corners of the ductwork. The insulation slabs shall be adhered to the duct with a suitable adhesive. On the underside of the duct the insulation shall be additionally secured by means of suitable nylon insulation hangers, fixed at maximum 300mm centres
 - b All joints shall be sealed with self-adhesive aluminium foil tape of a minimum width of 100mm. All insulation slabs shall be secured with a minimum of three self-adhesive tape bands per linear metre of ductwork
 - c If cold and damp conditions are anticipated during installation, consideration shall be given to utilising an aluminium foil tape with an acrylic adhesive
 - d Ensure vapour barrier is not damaged or punctured in any way
 - e Where aluminium is specified for final finish the cladding thickness shall be as specified.

Y30.3.9 DUCTWORK THERMAL INSULATION APPLICATION - MINERAL WOOL

- A Semi rigid slab insulation installation on ducts and plenums: Use only where permitted in Table 1. Secure with adhesive and insulation pins:
- 1 Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 per cent coverage of duct and plenum surface
 - 2 Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 - 3 Install stick pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a On duct sides with dimensions 450 mm and smaller, place pins along longitudinal centreline of duct Space 75 mm maximum from insulation end joints and 400 mm centre to centre
 - b On duct sides with dimensions larger than 450 mm, place pins 400 mm centre to centre each way and 75 mm maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing
 - c Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d Do not over compress insulation during installation
 - e Impale insulation over pins and attach speed washers
 - f Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 4 For ducts and plenums with surface temperatures below ambient do not use mineral wool.
 - 5 Create a facing lap for longitudinal seams and end joints with insulation by removing 50 mm from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 13mm outward-clinching staples at 25mm centres:
 - a Repair punctures, tears, and penetrations in foil finish with tape or mastic

- b Install end caps for ductwork and plenums. End caps shall consist of a vapour-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 75 mm.
 - 6 Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitred wedges cut to fit the elbow
 - 7 Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 150-mm wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 150 mm centres.
- B Provide additional mechanical support over the complete insulation comprising 0.9mm, 25mm mesh, galvanised wire netting drawn tightly around the insulation and secured with 0.9mm galvanised lacing wire.

Y30.3.10 PIPEWORK INSTALLATION OF CALCIUM SILICATE INSULATION

- A Insulation Installation on straight pipes and tubes:
- 1 Secure single-layer insulation with stainless-steel bands at 300mm intervals and tighten bands without deforming insulation materials
 - 2 Install two-layer insulation with joints tightly butted and staggered at least 75 mm. Secure inner layer with wire spaced at 300-mm intervals. Secure outer layer with stainless-steel bands at 300-mm intervals
 - 3 Apply a skim coat of mineral-fibre, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 25 mm. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.
- B Insulation Installation on pipe flanges:
- 1 Install preformed pipe insulation to outer diameter of pipe flange
 - 2 Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation
 - 3 Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
 - 4 Finish flange insulation same as pipe insulation.
- C Insulation installation on pipe fittings and elbows:
- 1 Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions
 - 2 When preformed insulation sections of insulation are not available, install mitred sections of calcium silicate insulation. Secure insulation materials with wire or bands
 - 3 Finish fittings insulation same as pipe insulation.
- D Insulation Installation on valves and pipe specialties:
- 1 Install mitred segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation
 - 2 Install insulation to flanges as specified for flange insulation application
 - 3 Finish valve and specialty insulation same as pipe insulation.

Y30.3.11 PIPEWORK INSTALLATION OF MINERAL-FIBRE INSULATION

- A Insulation installation on straight pipes and tubes:
- 1 Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials

- 2 Where vapour barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapour-barrier mastic and joint sealant
- 3 For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 150 mm centres
- 4 For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapour-barrier mastic and flashing sealant.

B Insulation installation on pipe flanges:

- 1 Install preformed pipe insulation to outer diameter of pipe flange.
- 2 Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation
- 3 Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fibre blanket insulation
- 4 Install jacket material with manufacturer's recommended adhesive, overlap seams at least 25 mm, and seal joints with flashing sealant.

C Insulation installation on pipe fittings and elbows:

- 1 Install preformed sections of same material as straight segments of pipe insulation when available.
- 2 When preformed insulation elbows and fittings are not available, install mitred sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D Insulation installation on valves and pipe specialties:

- 1 Install preformed sections of same material as straight segments of pipe insulation when available
- 2 When preformed sections are not available, install mitred sections of pipe insulation to valve body
- 3 Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
- 4 Install insulation to flanges as specified for flange insulation application.

Y30.3.12 PIPEWORK INSTALLATION OF PHENOLIC INSULATION

A General installation requirements:

- 1 Secure single-layer insulation with stainless-steel bands at 300-mm intervals and tighten bands without deforming insulation materials
- 2 Install 2-layer insulation with joints tightly butted and staggered at least 75 mm. Secure inner layer with 50mm self-adhesive aluminium foil tape spaced at 300mm intervals. Secure outer layer with stainless-steel bands at 300-mm intervals.

B Insulation installation on straight pipes and tubes:

- 1 Secure each layer of insulation to pipe with bands and tighten bands without deforming insulation materials
- 2 Where vapour barriers are indicated, seal longitudinal seams, with 50mm self-adhesive aluminium foil tape, end joints, and protrusions with vapour-barrier mastic and joint sealant
- 3 For below 0°C services install a factory applied vapour barrier as recommended by insulation material manufacturer.

C Insulation installation on pipe flanges:

- 1 Install preformed pipe insulation to outer diameter of pipe flange
- 2 Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation
- 3 Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

- D Insulation installation on pipe fittings and elbows:
- 1 Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

- E Insulation installation on valves and pipe specialties:
- 1 Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions
 - 2 Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3 Install insulation to flanges as specified for flange insulation application.

Y30.3.13 PIPEWORK INSTALLATION OF FLEXIBLE ELASTOMERIC NITRILE RUBBER INSULATION

- A Install closed cell nitrile rubber insulation strictly in accordance with the manufacturer's instructions. All lengths shall be close butted. All butt joints, longitudinal seams and joints at fittings shall be sealed with fire rated adhesive or equal and approved, to provide an unbroken vapour barrier.

- B Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

- C Insulation installation on pipe flanges:
- 1 Install pipe insulation to outer diameter of pipe flange
 - 2 Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation
 - 3 Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation
 - 4 Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

- D Insulation installation on pipe fittings and elbows:
- 1 Install mitred sections of pipe insulation
 - 2 Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

- E Insulation installation on valves and pipe specialties:
- 1 Install preformed valve covers manufactured of same material as pipe insulation when available.
 - 2 Ensure that valve covers fully protect flanges and bonnet with only the wheel and stem exposed. Seal with adhesive to prevent the ingress of water and water vapour
 - 3 When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation
 - 4 Install insulation to flanges as specified for flange insulation application
 - 5 Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

- F For external applications provide a weatherproof cladding or use the manufacturer's painted finish to provide UV and weather protection:

- 1 Weatherproof cladding: Use Aluminium sheet, Aluzinc or multi-layered aluminium polyester foil as described under clause "Protective cladding"
- 2 Manufacturer's paint application: Apply 2 or more coats of a water-based, fire rated, coating using an advanced terpolymer resin system to the manufacturer's recommended thickness
- 3 All fittings should be insulated to the same standards as the pipework insulation.

Y30.3.14 PROTECTIVE CLADDING APPLICATION

- A Provide, where indicated, protection of the type listed in Table 1 and Table 11 comprising aluminium, aluzinc or multi-layered aluminium/polyester foil.
- B Aluminium or aluzinc cladding: For pipework and circular ductwork where aluminium or aluzinc sheet cladding is indicated in Table 1 comply with the following:
- 1 Internal application:
 - a The sheet metal shall be formed to fit tightly over the outer circumference of the insulation with a longitudinal overlap of not less than 40mm. The outer part of the overlap shall be secured with self-tapping screws or rivets of the appropriate type at centres of not more than 150mm
 - b Circumferential overlaps shall be not less than 40mm and secured with self-tapping screws or rivets, not less than four, equally spaced. One circumferential joint should be left free at maximum intervals of 5 metres to allow for expansion and contraction. All joints shall be so arranged as to shed liquids. All joints shall be sealed with a suitable gun applied water-resistant sealant. All bends and fittings shall be covered with matching sheet metal tailored to fit and sealed. End joints shall be covered with a 38mm wide strip and purpose made caps.
 - 2 External application: Weatherproof finish is required:
 - a Insulation for the top surface of horizontal ducts shall be factory prepared to provide a fall of 1:25. The minimum thickness of insulation shall be maintained including at all flanges and supports
 - b Special care should be taken to avoid electrolytic corrosion. The joints used on adjacent metal sheets shall be selected from one of the types shown in BS 5970 Figure 43. All joints shall be sealed with a water and weatherproof gun applied sealant. Blind rivets or screws shall be spaced not more than 100mm apart. At the junction between pre-formed insulating materials and fixed steelwork, the joint shall be packed with mineral fibre to accommodate differential thermal movement
 - c The cladding shall be additionally secured with metal banding at 450mm centres. The banding shall be selected to complement the sheet cladding and not contribute to bi-metal corrosion.
- C Multi-layered aluminium foil/polyester sheet cladding: Where multi-layered aluminium foil/polyester sheet is permitted comply with the following:
- 1 Self-adhesive foil: Comply with manufacturer's instructions for correct method of application
 - 2 All seams must be taped with manufacturer's recommended jointing tape
 - 3 Ensure that there is a minimum overlap of 75mm. For weatherproof applications ensure the edge of the sealing flap faces downwards
 - 4 For external applications the insulation for the top surface of horizontal ducts shall be factory prepared to provide a fall of 1:25. The minimum thickness of insulation shall be maintained including at all flanges and supports
 - 5 Repair any areas of damage in accordance with manufacturer's instructions.
- D Provide thermal insulation to all valves, flanges, strainers and all ancillaries. The insulation shall be suitable for the service to be insulated. Insulation by one of the following methods and ensure that it provides the same thermal resistance as the adjoining pipework.
- E Chilled and cold water valves, strainers and ancillaries to have a coating of self-adhering thermal insulating cement to fill the voids of the irregularly shaped items prior to applying the insulation box or jacket.
- F Provide removable and reusable boxes or jackets to all pipework ancillaries including the following: Valves:
- 1 Strainers
 - 2 Commissioning stations.
- G Boxes or jackets to be aluminium type, flexible jackets or fabricated phenolic foam enclosures used as follows:
- 1 Aluminium boxes application: Use in the following locations:
 - a External hot and cold services
 - b Hot, chilled or cold services in plantrooms.

- 2 Flexible jackets application: Use in the following locations:
 - a Hot pipework in roof, ceiling or floor voids
 - b Hot pipework in plantrooms.
- 3 Fabricated phenolic foam enclosures application: Use in the following locations only:
 - a Chilled and cold-water pipework in roof, ceiling and floor voids.
- H Aluminium boxes shall be of the split casing type fabricated from 1.2mm aluminium sheet and having spring clip fasteners and neoprene or similar seals. Fabricate boxes as per BS 5970 Figures 25 and 26.
- I Flexible thermal insulation jackets shall be secured by way of drawstring collars and Velcro fasteners. The outer layer of the valve cover shall be aluminised polyester film coated glass fabric. The inner layer shall be a woven glass fibre fabric, capable of withstanding a continuous hot face temperature of 260°C.
- J Fabricated phenolic foam enclosures application: Comprising aluminium foil faced phenolic section and sheet, fabricated or factory made and suitably vapour sealed.

Y30.3.15 PENETRATIONS (NON-FIRE RATED)

- A Insulation installation at roof penetrations: Install insulation continuously through roof penetrations:
 - 1 Seal penetrations with flashing sealant
 - 2 For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant
 - 3 Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing
 - 4 Seal jacket to roof flashing with flashing sealant.
- B Insulation installation at underground exterior wall penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C Insulation installation at above ground exterior wall penetrations: Install insulation continuously through wall penetrations:
 - 1 Seal penetrations with flashing sealant
 - 2 For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant
 - 3 Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm)
 - 4 Seal jacket to wall flashing with flashing sealant.
- D Insulation installation at interior wall and partition penetrations (that are not fire rated): Install insulation continuously through walls and partitions.
- E Insulation installation at floor penetrations: Install insulation continuously through floor penetrations.

Y30.3.16 PENETRATIONS (FIRE RATED)

- A Ensure that all service penetrations through fire compartment walls are completely sealed. Sealing compounds shall be of an approved fire rated material.
- B Pre-installation inspection:
 - 1 Examine the areas and conditions under which the fire stops are to be installed and correct any unsatisfactory conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner suitable to the CA / client.
- C Post installation inspections:

- 1 Examine and ensure that the fire stops have been installed in the correct manner fully in accordance with the manufacturer's recommendations
- 2 Ensure that the fire stops are approved by the relevant local authorities or building control officer
- 3 In the event of problems arising with either the installation or approval of the fire stops provide the services of an experienced authorised representative of the manufacturer or supplier of the equipment to visit site to inspect, check, adjust if necessary and approve installation of all fire stops to ensure they are acceptable to the CA and all authorities having jurisdiction over the installation.

D Sealing of metal pipes and conduits:

- 1 Seal penetrations through fire compartmented foundations, floors and walls for metal pipes cables and conduits by the application of proprietary fire safe plugs made from high grade fire resistant synthetic rubber:
 - a These plugs shall consist of two identical pieces, which can be installed after the line itself has been installed. The plug shall have serrated outer and inner profiles so that the two sections can be pushed, without difficulty, into the annulus shall be sealed. One side of the plug shall have a flanged edge to prevent it being pushed too deeply into the annulus. The plug shall be able to withstand a maximum pressure difference of 2 bar and operate satisfactorily within a temperature range -10 to +90°C
 - b Where possible multiple passage conduits may be used where each line is sealed individually with its own sealing plug. Plugs shall be installed on both sides of each sleeve
 - c For insulated pipes provide an insulated fire sleeve of the same thickness as the adjoining thermal insulation. Sleeve to comprise fire rated rockwool and graphite compound. Space between the fire sleeve and the metal cast in sleeve to be filled with intumescent mastic seal.

E Sealing of plastic pipes:

- 1 Penetrations through fire compartmented foundations, floors and walls for plastic pipes shall be sealed by the application of proprietary fire safe plastic pipe sleeves:
 - a These shall consist of a metal collar in two parts filled with intumescent material. This intumescent material upon coming into contact with a fire or temperature in excess of 250°C will foam up vigorously completely closing the opening. The collar shall have a split construction allowing it to be installed around existing lines. Collars shall be installed on both sides of each structure
 - b For insulated pipe the insulation to be installed continuously through the penetration.

Y30.3.17 STEAM / MTHW HEATING CALORIFIER INSULATION

- A Provide 100mm thick mineral wool slabs held in place with aluminium bands at approximately 250mm centres. Aluminium cladding shall be applied generally in line with pipework in plantrooms.

Y30.3.18 LOW TEMPERATURE HWS CALORIFIER INSULATION

- A The insulation shall be bright Class O foil faced and be 80mm of mineral wool slab 120 kg/m³. Insulation shall be installed in a similar manner to that illustrated for heating pipework in plantrooms but employing a 100mm wide aluminium foil tape. Aluminium cladding shall be applied generally in line with pipework in plantrooms.

Y30.3.19 COLD, CHILLED WATER STORAGE TANK AND FEED AND EXPANSION TANK (INTERNAL) INSULATION

- A Apply CFC-free 40mm thick Class O, foil-faced phenolic foam to all sides with slabs shaped to clear flanges, access covers etc. All joints shall be sealed with 100mm wide self-adhesive aluminium foil tape. In plantrooms and boiler houses the tank shall be aluminium clad, fitted overall and arranged with quick release fastenings to facilitate removal and inspection of the tank.

Y30.3.20 FLUE PIPE INSULATION

- A The insulation shall be 75mm thick mineral wool wired mattress, faced on both sides with 25mm galvanised wire mesh, stitched with wire. The mattress shall be supported all over on expanded metal mesh with mild steel studs, nuts and washers at 300mm pitch throughout, to provide a 25mm continuous air space. The mattress shall be flushed fitting and secured by means of galvanised wire netting, 25mm mesh by 0.7mm.
- B The final covering shall be aluminium sheeting 1.2mm thick with joints secured with self-tapping cadmium plated screws or rivets. Insulation and sheeting over flanges / joints and inspection covers etc shall be removable. On external flues the aluminium sheeting shall be 1.9mm thick and arranged to shed water and all overlaps and joints shall be sealed with a suitable gun applied sealant.

Y30.3.21 FUEL OIL AND TANK INSULATION

- A External unheated oil storage tanks may be left un-insulated. But if prolonged periods below -8°C may be experienced or if the tanks serve life safety generators then the tanks are to incorporate electric immersion heaters to maintain the oil temperature above -4°C. In this event the tanks are to be insulated and the exposed distribution pipework will also require to be trace heated and insulated in accordance this specification.
- B Heated oil storage tanks shall be insulated with mineral wood wired mat 128kg/m³ density having a 25mm galvanised wire mesh stitched to one side. The insulation shall have a factory applied reinforced aluminium foil finish, thickness of 80mm, and a thermal conductivity not exceeding 0.044 W/mK (ref 100°C). Aluminium cladding shall be applied. Aluminium retaining bands shall be provided at 450mm centres.

Y30.3.22 TRACE HEATING TAPE INSTALLATION

- A Hot water maintenance tapes type HWMT 1, 2 & 3:
- 1 Comply with manufacturer's installation instructions
 - 2 Install heating cable in a straight line under the thermal insulation
 - 3 Install on dry surfaces only
 - 4 Tie cables at maximum of 300mm centres
 - 5 Apply heating tape to 45° angle from underside of pipe and outside of pipe bends
 - 6 Do not spiral tape around the pipe
 - 7 Avoid damage to cable
 - 8 Do not clamp cable at pipe supports.
- B Frost protection tapes type FPT 1, 2, 3, 4 & HWTM1:
- 1 Comply with manufacturer's installation instructions
 - 2 Install heating cable in a straight line under the thermal insulation
 - 3 Install on dry surfaces only
 - 4 Tie cables at maximum of 300mm centres
 - 5 Apply heating tape to 45° angle from underside of pipe and outside of pipe bends
 - 6 Do not spiral tape around the pipe
 - 7 Avoid damage to cable
 - 8 Do not clamp cable at pipe supports
 - 9 For valves larger than 50mm cross tape around valve and round spindle
 - 10 Insulate all valves.

Y31 MECHANICAL VIBRATION CONTROL

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Y31.1 PART 1 – GENERAL

- A This section relates to the prevention of unwanted vibration transmission from mechanical and electrical items of equipment to sensitive areas inside and outside the building.
- B Fabricate, assemble, deliver to site and install vibration control measures to meet the performance standards specified.
- C In seismic control areas provide anti vibration mountings suitable for the zonal classification of the area.
- D Note the requirement to reselect vibration control equipment to suit the final actual operating weights and speed of operation of plant.

Y31.1.2 RELATED DOCUMENTS

- A For drawings and general provisions of the Contract refer to main Contract Preliminaries.
- B Related Sections include the following:
 - 1 U10 Ventilation Systems
 - 2 U80 Ductwork and Ancillaries
 - 3 Y30 Mechanical Thermal Insulation
 - 4 Y32 Mechanical Plant and equipment identification
 - 5 Y50 Testing and commissioning.

Y31.1.3 SUMMARY

- A This Section includes the following:
 - 1 Un-housed Spring Mounts (Type S)
 - 2 Vertically Restrained Spring Mounts (Type L)
 - 3 Pre-Compressed Moulded Glass Fibre Mounts (Type F)
 - 4 Spring Compression Hangers (Type H)
 - 5 Ductwork and pipework spring hangers
 - 6 Kinetic Neoprene Mounts (Type N)
 - 7 Equipment Inertia Bases (Type S-I) with un-housed spring mounts
 - 8 Inertia Bases (Type L-I) with vertically restrained spring mounts
 - 9 Inertia Bases (Type F-I) with moulded glass fibre mounts
 - 10 Steel Base Frames (Type S-B) with un-housed spring mounts
 - 11 Steel Base Frames (Type L-B) with vertically restrained spring mounts
 - 12 Flexible Pipe / Ductwork Connections.

Y31.1.4 DEFINITIONS

- A Inertia Base: A concrete block mounted on resilient supports designed to reduce movement by lowering the centre of gravity.

Y31.1.5 PERFORMANCE REQUIREMENTS

- A For design maximum background noise levels refer to section B of this specification. Ensure also that vibration levels are not detrimental to occupational health and comply with BS 6472-1.
- B Select vibration control equipment to ensure that these levels are not exceeded.
- C For equipment exposed to wind forces ensure that the method of support is sufficient to cater for the design wind speeds and the overcapacity recommended for the location.

Y31.1.6 SUBMITTALS

- A Provide a fully documented set of the calculations upon which the vibration equipment has been selected. Calculations to be available for review four weeks prior to ordering the equipment.
- B Product Data: For the following:
 - 1 Include rated load, rated deflection, and overload capacity for each vibration isolation device
 - 2 Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of - restraint component used:
 - a Tabulate types and sizes of restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction
 - b Annotate to indicate application of each product submitted and compliance with requirements.
- C Co-ordination Drawings: Show coordination of all anti-vibration equipment with other systems and equipment in the vicinity, including other supports and seismic restraints (if any).
- D Field quality-control test reports.
- E Operation and Maintenance Data: For all vibration isolation equipment to include in operation and maintenance manuals.

Y31.1.7 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 will be exposed.
- B Ensure that the whole installation complies with the relevant standards, including the following:
 - 1 BS 4800 - Schedule of paint colours for building purposes
 - 2 BS 6472-1 - Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting
 - 3 BS EN ISO 9001 - Quality management systems: Requirements.

Y31.1.8 CO-ORDINATION

- A Co-ordinate the fixing requirements for all equipment.
- B Co-ordinate the installation of the concrete in inertia bases.

Y31.2 PART 2 – PRODUCTS

Y31.2.1 VIBRATION ISOLATORS - GENERAL

- A Supply and install vibration isolators as indicated on the vibration isolation schedules and also wherever necessary to limit vibration transmission into the building structure, supporting structure, pipework or ductwork.
- B Ensure that any vibration transmitted from the mechanical and electrical services installations into the building structure does not cause the specified background noise levels to be exceeded.
- C Ensure that the maximum vibration amplitudes specified in BS 6472-1 or ASHRAE guidelines are not exceeded.
- D Select vibration isolators so that they are suitable for the loading, operating and environmental conditions which will prevail. Pay special attention to vibration isolators exposed to atmospheric or adverse interior conditions and apply appropriate finishes to prevent corrosion.
- E The static deflection of vibration isolators shall be selected to give the necessary degree of isolation efficiency under the lowest normal operating speed of the isolated plant. Selection shall allow for asymmetric load distribution such that the minimum static deflection is achieved on all vibration isolators under normal operating conditions. All machines and bases shall be carefully levelled. Replace any vibration isolators which are “bottomed out” or where the springs have deformed from a cylindrical shape at no extra cost to the contract.
- F All vibration isolators shall be colour coded or otherwise clearly marked to indicate rated load and deflection capacity to facilitate identification during installation.
- G All external connections to vibration isolated plant shall be made using flexible connections. Particular care shall be taken to ensure that the connection of pipes, ducts, shafts, electrical conduit etc, to vibration isolated plant neither short circuits the plant vibration isolation, nor impedes the free movement of the vibration isolated plant.
- H The vibration isolation system shall be selected to support the operating weight of the plant and equipment to be isolated only. All associated pipework, valves, filters, ductwork etc, and their contents shall be supported independently so as not to impose additional forces on the isolator system. All flexible connections shall be selected and arranged to accommodate this requirement.
- I All plant, pipework and ductwork shall be resiliently isolated from any part of the building structure as specified, or as otherwise required, to achieve the specified noise and vibration criteria. Particular attention shall be paid to areas where low noise levels are specified. The mounting of any item of plant, pipework or ductwork from lightweight (stud) partitions is not permitted.
- J Select spring mounts with an overload capacity of 50% and with an outside diameter of at least 75% of the operating height. Mark mounts permanently with load capacity.

Y31.2.2 VIBRATION ISOLATION PLANT AND EQUIPMENT

- A Unless otherwise stated, plant and equipment isolators shall be provided as indicated on the following schedules. For specification of isolator types refer to the following clauses. Isolators must be selected for the operating weight of equipment, speed of equipment rotation, structural span of floor plate and shall be positioned for equal deflection.
- B Un-housed Spring Mounts (Type S):
 - 1 Free standing, un-housed spring
 - 2 Laterally stable
 - 3 Steel spring
 - 4 Top and bottom load plate

- 5 Levelling bolt.
- C Vertically Restrained Spring Mounts (Type L):
- 1 High strength; low stress helical steel spring
 - 2 Springs capped with steel pressure plate on neoprene base pad
 - 3 Base plate pre-primed for bolting down and painted for protection
 - 4 Lockable levelling device to limit the vertical movement.
- D Pre-compressed Moulded Glass Fibre Mounts (Type F):
- 1 Mounts: Inert inorganic material covered with an elastomeric coating to increase damping and protect the glass fibres
 - 2 Isolation pad bonded to a steel load transfer washer and formed steel bolt down bracket
 - 3 Steel bolt with a neoprene grommet.
- E Spring Compression Hangers (Type H):
- 1 Provide where indicated on the vibration isolation schedule spring hanger mountings. In addition spring hangers shall be used to support all pipework and ductwork connected to rotating and reciprocating machinery within plantroom areas or within 15 m of the plant whichever is the lesser
 - 2 When used for supporting pipework and ductwork the springs shall have a minimum deflection of 25mm unless otherwise stated
 - 3 The hangers shall comprise:
 - a Steel spring or glass fibre pad or a combination of both retained in a welded steel bracket
 - b Spring: free standing, un-housed and laterally stable having a horizontal spring stiffness equal to or greater than 1.3 times the vertical stiffness
 - c Hanger bracket designed to carry five times overload without failure and shall allow up to 15° rod misalignment without metal to metal contact.
- F Kinetic Neoprene Mounts (Type N):
- 1 Moulded neoprene isolators
 - 2 Cast in tapped steel load plate to permit bolting to supported equipment
 - 3 Cast in steel anchor base plate pre-drilled for holding down bolts
 - 4 Neoprene to be oil and corrosion resistant.
- G Inertia Bases (Type S-I): Provide where indicated on the vibration isolation schedule inertia bases manufactured from welded steel channels designed to receive concrete poured into the steel frame. The steel frame shall incorporate pre-located equipment anchor bolts and free-standing laterally stable spring mounts generally as described under type S mounts.
- H Inertia Bases (Type L-I): Provide where indicated on the vibration isolation schedule inertia bases generally as type S-I except that the springs shall be type L vertically restrained.
- I Inertia Bases (Type F-I): Provide where indicated on the vibration isolation schedule inertia bases generally to type S-I except that the isolators shall be moulded glass fibre isolators as described under type F mounts.
- J Steel Base Frames (Type S-B): Provide where indicated on the vibration isolation schedule steel frame bases manufactured from structural steel members incorporating isolator mounting brackets and supported by free standing spring isolators as described under type S mounts.
- K Steel Base Frames (Type L-B): Provide where indicated on the vibration isolation schedule steel beam bases manufactured from structural steel members incorporating isolator mounting brackets and supported by vertically restrained spring isolators as described under type L mounts.
- L Flexible Pipe / Ductwork Connections:
- 1 All pipework and ductwork connected to rotating or reciprocating equipment shall be isolated by means of flexible connections described in the relevant pipework and ductwork sections of this specification.

Care must be taken to ensure that isolation mounts are not bridged by rigid connections such as electrical conduits or small obstructions underneath the floating equipment

- 2 Provide acoustic seals around all pipework and ductwork penetrations through plantroom enclosures
- 3 Flexible connections shall be fitted to all pump suction and discharge connections, chillers, cooling towers, and other centrifugal, reciprocating or vibrating equipment, where anti-vibration and inertia mounts are fitted.

Y31.2.3 VIBRATION ISOLATION SCHEDULE

Equipment type	Equipment location									
	Basement		Ground or up to 6m floor span		9m floor span		12m floor span		15m floor span	
	Isolator type	Static deflection (mm)	Isolator type	Static deflection (mm)	Isolator type	Static deflection (mm)	Isolator type	Static deflection (mm)	Isolator type	Static deflection (mm)
Axial Fan and Low Pressure Centrifugal Fans (Up To 75mm) and Air Handling Units										
Suspended units (up to 4 kW)	H	19	H	25	H	25	H	25	H	25

Y31.3 PART 3 - EXECUTION

Y31.3.1 EXAMINATION

- A Examine areas and equipment to receive vibration isolation and seismic- and wind -control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C Proceed with installation only after unsatisfactory conditions have been corrected.

Y31.3.2 APPLICATIONS

- A Multiple Pipe Supports: Secure pipes to trapeze member in accordance with section Y10.
- B Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic or wind forces.

Y31.3.3 VIBRATION-CONTROL DEVICE INSTALLATION

- A Comply with manufacturer's requirements.
- B Equipment supports:
 - 1 Ensure equipment is selected for the actual loading conditions
 - 2 Ensure that vibration isolation efficiency is not compromised by bridging cabling or other means.
- C Piping Restraints:
 - 1 Comply with requirements in Y10
 - 2 Space lateral supports in accordance with Y10.
- D Install cables so they do not bend across edges of adjacent equipment or building structure.
- E Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- F Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- G Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- H Drilled-in Anchors:
 - 1 Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines
 - 2 Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength
 - 3 Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened
 - 4 Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive
 - 5 Set anchors to manufacturer's recommended torque, using a torque wrench
 - 6 Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.
- I Install flexible connections as follows:

- 1 Where services cross building expansion joints
- 2 Where pipework is connected to rotating equipment
- 3 Where ductwork is connected to rotating equipment
- 4 Where electrical cables could bridge vibration mounts.

Y31.3.4 FIELD QUALITY CONTROL

- A Perform tests and inspections.
- B Tests and Inspections:
- 1 Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction
 - 2 Schedule test with CA with at least seven days' advance notice
 - 3 Measure isolator restraint clearance
 - 4 Measure isolator deflection
 - 5 If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
 - 6 Remove and replace malfunctioning units and retest as specified above.
 - 7 Prepare test and inspection reports.

Y31.3.5 ADJUSTING

- A Adjust isolators after piping system is at operating weight.
- B Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C Adjust active height of spring isolators.
- D Adjust restraints to permit free movement of equipment within normal mode of operation.

Y31.3.6 DEMONSTRATION

- A Engage manufacturer to train employer's maintenance personnel to adjust, operate, and maintain vibration control devices.

Y32 MECHANICAL IDENTIFICATION

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Y32.3.6	WARNING-TAG INSTALLATION

Y32.1 PART 1 – GENERAL

- A This section covers the identification of all services through the use of coloured bands, indicators and labels.
- B Identify all plant and equipment with a unique reference number with type description relating to the references used in the record drawings.
- C Identify the nature of all materials conveyed in all pipework and ductwork by the use of colour coded bands and direction of flow indicators.
- D Provide a system of denoting valves, dampers, control sensors and the like with a suitable alphanumeric labelling system for the approval of the CA.

Y32.1.2 RELATED DOCUMENTS

- A For drawings and general provisions of the contract refer to contract preliminaries.
- B Related Sections include the following:
 - 1 Y10 & 11 Pipework Valves and accessories
 - 2 Y30 Thermal Insulation
 - 3 S12 Water Treatment systems
 - 4 U10 Ventilation Systems
 - 5 U82 Fans
 - 6 U88 Air Terminal Devices
 - 7 Y30 Mechanical Thermal Insulation
 - 8 Y31 Vibration Isolation Mountings
 - 9 Y32 Mechanical Plant and equipment identification
 - 10 Y50 Testing and commissioning.

Y32.1.3 SUMMARY

- A This section includes:
 - 1 Equipment labels
 - 2 Warning signs and labels
 - 3 Pipe labels
 - 4 Duct labels
 - 5 Stencils
 - 6 Valve tags
 - 7 Warning tags.

Y32.1.1 PERFORMANCE REQUIREMENTS

- B 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.
- C 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.
- D Comply with the requirements for labels, notices and warning signs as identified in:
 - 1 BS 1710 - Specification for identification of pipelines and services
 - 1 BS 4800 - Schedule of paint colours for building purposes
 - 2 BS EN ISO 7010 + A7: Graphical symbols. Safety colours and safety signs. Registered safety signs.
 - 3 For Hospital projects: HTMs and HBNs.
 - 4 Local Utility Company regulations

- E Provide labels and notices as required and provide:
- 1 Identification of all equipment in line with the project established system as indicated on the drawings and O& M Manuals.
 - 2 Warning notices and labels for:
 - a Rotating machinery
 - b Pressurised equipment and vessels
 - c High Temperature equipment
 - d Gas suppression systems and associated control equipment
 - e Warning notices and labels for all plantrooms
 - f Life Safety equipment
 - 3 Periodic inspection and test notices
 - 4 Identification of all services indicating:
 - a Service being conveyed
 - b Flow "F" or Return "R"
 - c Temperatures if needed to identify different type of heating or chilled water
 - d Valves & Pipeline mounted equipment
 - e Dampers & ductwork mounted equipment
 - f Control devices, sensors, actuators
 - g Access locations
- 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.

Y32.1.4 SUBMITTALS

- A Samples of each type of label and identification band for approval of the CA.
- B Samples: For colour, letter style, and graphic representation required for each identification material and device.
- C Equipment Label Schedule: Include a listing of all equipment to be labelled with the proposed content for each label.
- D Valve and equipment numbering scheme.
- E Valve Schedules: For each piping system to include in maintenance manuals.

Y32.1.5 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 shall be exposed.
- B Ensure that the whole installation complies with the relevant standards, including the following:
- 1 BS 1710 - Specification for identification of pipelines and services
 - 2 BS 4800 - Schedule of paint colours for building purposes
 - 3 BS EN ISO 7010 + A7: Graphical symbols. Safety colours and safety signs. Registered safety signs.
 - 4 BS ISO 3864-1: Graphical symbols. Safety colours and safety signs. Design principles for safety signs and safety markings
 - 5 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 Health and Safety (Safety Signs and Signals) Regulations 1996.

- 5 Health and Safety at Work etc Act 1974.
- 6 Health and Safety (First-aid) Regulations 1981
- 7 Management of Health and Safety at Work Regulations 1999.
- 8 Workplace (Health, Safety and Welfare) Regulations 1992.

Y32.1.6 CO-ORDINATION

- A Co-ordinate identification names, abbreviations, colours, and other features with requirements in other Sections requiring identification applications, Drawings including schematics, 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 Co-ordinate 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 locations of access panels and doors.
- D Install identifying devices before installing acoustic ceilings and similar concealment.

Y32.2 PART 2 – PRODUCTS

Y32.2.1 EQUIPMENT IDENTIFICATION

A Within Buro Happold a standardised method of equipment referencing has been set up. Use this referencing system for labelling system 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, Fan Coil Unit No. 6 on level 13 would be:

FCU - 13 - 06

C Standard Mechanical Services Equipment Acronyms are given in the table below and for the complete list refer to schedule "MEP services Equipment Standard Acronyms".

EQUIPMENT DESCRIPTION	EQUIPMENT ACRONYM
AIR HANDLING	
EXHAUST/EXTRACT FAN	EF
EXTRACT GRILLE	EG
LOUVRE	L
DRAINAGE	
RODDING EYE	RE

D For distributed MEP services refer to the schedule "Acronyms Distributed Services". A few examples are:

	Above Ground Foul Drainage
SP	Soil Pipe
VP	Vent Pipe
WP	Waste Pipe
SS	Soil Stack
SVP	Soil & Vent Pipe
WVP	Waste Vent Pipe
	Hot & Cold Water Supply
HWS	Domestic Hot Water Service
CWS	Domestic Cold Water Service

Y32.2.2 EQUIPMENT LABELS, CHARTS, NAMEPLATES

- A All plant, equipment and services shall be clearly labelled in English to denote the function of the plant or the service being conveyed and the direction of flow.
- B All valves, dampers and controls shall be designated by distinguishing numbers in English in the charts or diagrams. All plant room valves and every circuit control valve shall be provided with an ivory or approved plastic discs engraved with a reference number. All discs shall be 35mm, white with black lettering, and securely attached.
- C All access doors to plant areas or items of plant shall 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.
- D The contractor shall provide separate lists designating the location and function of each valve, damper and control.
- E Submit the charts, diagrams and lists for approval by the CA of sizes, type and characters used.
- F Upon completion of the work, label all electrical and control cable runs.
- G Furnish four sets of diagrammatic charts showing the complete installation schematically with major control valves, etc. and number thereof. Such charts shall be mounted in frames and located as directed.
- H Control panels, distribution boards and sub-mains, gauges, thermometers, voltmeters, ammeters and other instruments shall be clearly indicated by engraved nameplates in English.
- I Each unit of equipment shall be identified by a permanently attached nameplate in English made of brass, other corrosion resistant metal or white plastic with black laminated core. Plates shall be not less in size than 42mm × 80mm. Plates shall bear information pertaining to the units as follows:
 - 1 System and unit designation from schedule of equipment
 - 2 Manufacturer's name and address
 - 3 Serial and model numbers
 - 4 Rated capacity
 - 5 Temperatures, pressure or other limitations.
- J Care shall be taken to ensure that plates can be read without difficulty. Submit details of lettering, method of mounting / supporting to the CA for approval prior to manufacture.
- K If required by Building Regulations, issue client with Energy Performance Certificate, mounted in frame.

Y32.2.3 PIPEWORK AND DUCTWORK IDENTIFICATION

- A Thermal insulation exposed to view shall be painted except where the insulation is protected by aluminium foil or sheet, plastic film or a weatherproof finish. An undercoat and not less than two finishing coats shall be applied. Absorbent surfaces shall also receive an initial coat of priming paint. All paints shall be compatible with the surfaces to which they are applied.
- B The colour(s) of paint(s) shall be to the instructions of the CA and shall be selected from the range contained in BS 4800 or equivalent standard.
- C All distribution services shall be colour coded and provided with symbols for identification purposes. Identification coding for ductwork, including thermal insulation, shall be in accordance with HVCA Specification DW 144 Appendix B. For pipework including thermal insulation, the basic colour and colour coding shall be in accordance with BS 1710 or equivalent standard.
- D Provide bands at least 300mm wide or colour triangles of at least 150mm wide. The bands or triangles shall be spaced and located to permit ready identification of the services. Identification shall be provided in the following locations:
 - 1 Adjacent to valves

- 2 Adjacent to equipment
 - 3 Passage through walls
 - 4 Not more than 3.5m intervals in plantrooms
 - 5 At a maximum of 15m intervals elsewhere
 - 6 Adjacent to access points.
- E In addition to colour bands or triangles, all pipework in plant rooms and service areas, whether insulated or not, shall be legibly marked (in English) with adhesive black or white letters and triangles to show the type of service and the direction of fluid flow.
- F Service shall be shown as follows:
- 1 Supply air: S
 - 2 Return air: R
 - 3 Fresh air: FA
 - 4 Exhaust air: E.
- G The letters F and R shall be added to piped distribution to show flow and return respectively.
- H Where recycled, non-potable water is conveyed in the building, labelling of pipework and outlets will be in accordance with BS 8515 Annex C. Pipework labels shall have "Rainwater" or similar in black lettering and be at no greater than 0.5m intervals.

Y32.2.4 DANGER AND WARNING NOTICES

- A Comply with the requirements of British standards, codes of practice and HSE guidance notes.

Y32.3 PART 3 - EXECUTION

Y32.3.1 PREPARATION

- A Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

Y32.3.2 EQUIPMENT LABEL INSTALLATION.

- A Install or permanently fasten labels on each major item of mechanical equipment.
- B Locate equipment labels where accessible and visible.

Y32.3.3 PIPE LABEL INSTALLATION

- A Piping Color-Coding: Painting of piping is specified in Y10. In addition provide arrows indicating the direction of flow.
- B Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - C Near each valve and control device.
 - D Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - E Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - F At access doors, manholes, and similar access points that permit view of concealed piping.
 - G Near major equipment items and other points of origination and termination.
 - H Spaced at maximum intervals of 15 m each run. Reduce intervals to 7.5 m in areas of congested piping and equipment.
 - I On piping above removable acoustical ceilings. Omit intermediately spaced labels.

Y32.3.4 DUCT LABEL INSTALLATION

- A Install duct labels with permanent adhesive on air ducts and indicate as follows together with arrows indicating the direction of flow:
 - 1 Supply air: S
 - 2 Return air: R
 - 3 Fresh air: FA
 - 4 Exhaust air: E
- B Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 15 m in each space where ducts are exposed or concealed by removable ceiling system.

Y32.3.5 VALVE-TAG INSTALLATION

- A Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; taps; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

Y32.3.6 WARNING-TAG INSTALLATION

A Write required message on, and attach warning tags to, equipment and other items where required.

Y50 TESTING AND COMMISSIONING OF MECHANICAL AND ELECTRICAL SERVICES

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Y50.1 PART 1 – COMMISSIONING AND TESTING GENERAL

Y50.1.1 RELATED DOCUMENTS

- A For drawings and general provisions of the Contract, including main Contract Preliminaries refer to 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 For Mechanical services, related sections include the following specification sections:
- 1 P: P30
 - 2 R: R10, R11
 - 3 S: S10, S12, S18, S20, S30, S32, S33, S41, S51, S60, S61, S62, S63, S64, S65, S66, S70, S76
 - 4 T: T10, T20, T24, T26, T30, T36, T40, T41, T42, T43, T50, T51, T60, T61
 - 5 U: U10, U12, U14, U21, U24, U41, U42, U60, U80, U81, U82, U83, U84, U86, U87, U88
 - 6 Y: Y10, Y11, Y12, Y20, Y21, Y31, Y32, Y41
- E For Electrical Services, related sections include the following:
- 1 P: P30
 - 2 V: V10, V11, V12, V14, V20, V21, V22, V23, V24, V30, V31, V40, V44, V50, V51, V55, V56, V57, V59, V60, V80, V81
 - 3 W: W11, W16, W20, W31, W40, W41, W44, W50, W51, W52, W54, W60

Y50.1.2 SUMMARY

- A This section provides a framework for the testing, regulation and commissioning procedures to be employed for the building services installations. It requires the appointment of an independent Commissioning Management Specialist to programme, manage and accept the testing and commissioning. The physical testing and commissioning is to be carried out by the trade contractors for each of the various installations using their own commissioning sub-contractors.
- B The scope of the works in this section may be divided into these 5 stages:
- 1 Pre-installation stage
 - 2 Installation stage
 - 3 Commissioning stage
 - 4 Handover and Training of the Employer’s personnel
 - 5 Post Occupation
- C The complete scope of works is indicated in section 2 of this specification.

Y50.1.3 DEFINITIONS

- A The following terms used in this specification have the following meanings:
- 1 **Commissioning:** The process of verifying that all the building services systems are set into operation, regulated and integrated with each other to achieve the design operating parameters in line with the employer’s requirements. It includes the recording of the system performance and the system control settings.
 - 2 **Testing:** A process that is undertaken to prove the quality of the installation and the workmanship.
 - 3 **Trade Contractor:** Company responsible for the installation of packages of work such as, mechanical services, plumbing systems, electrical services, ductwork services, building management systems, fire alarm systems, lifts and other specialist work packages.

- 4 **CMS:** Commissioning Management Specialist. The independent person or company appointed to carry out the Commissioning Management, Documentation and Acceptance activities identified in this specification. Employed by Main Contractor or directly by the employer as indicated in the contract preliminaries.
- 5 **CSC:** Commissioning sub-contractor: Person or company appointed by the trade contractor/s to commission their respective portions of the Building services installations. This could be a number of different agencies for such things as:
 - a Pipework installation
 - b Ductwork Installation
 - c Electrical installation
 - d Fire alarm installation
 - e Other specialist building services systems
- 6 **TDS:** Technical Document Specialist appointed by the Commissioning Management Specialist to prepare the record documents and collate the record drawings in line with this specification
- 7 **Independent:** In the context of a Commissioning Management Specialist this means that the person or company must not be in the direct employ of the Building services sub-contractor/s.
- 8 **Record Documents:** these are prepared by TDS and comprise, Building Logbook and/or Building Manual, Building User Guide and Operation and Maintenance Manuals
- 9 **Building Logbook:** Document using the templates of CIBSE TM 31 to fulfil the requirements of Building Regulations Part L (Conservation of Fuel and power). May be incorporated into the Building Manual.
- 10 **Building User Guide:** Prepared according to the templates of BSRIA – BG2011 Building Manuals and User Guides. It provides building/site specific guidance for the non-technical building user. The purpose of the guide is to help building users access, understand and operate the building efficiently and in a manner in keeping with the original design intent. A Building User Guide should provide easily accessible and understandable information relevant to the following stakeholders:
 - a The building's staff (or where relevant residents)
 - b The non-technical facilities management team/building manager
 - c Other building users, e.g. visitors/community users.
- 11 **Building Manual:** This is intended to be a concise operator's guide to the building using the templates of BSRIA – BG2011 Building Manuals and User Guides. It does not take place of the O& M Manuals but is for use by:
 - a Facilities Manager
 - b Facilities Management Team
 - c Visiting tradesmen carrying out works in the building
- 12 **Operation and Maintenance Manual:** In this document it defines the requirements, procedures for the effective operation, maintenance and replacement of the building services plant and equipment installed within the building.
- 13 **Asset Register:** An asset register is used to record the specification, make and model details of equipment and plant within a building. It is used for both planned and reactive maintenance services to ensure the service schedule meets specifications.

Y50.1.4 REPSONSIBILITIES FOR TESTING AND COMMISSIONING

- A The responsibilities for the commissioning of the services installations are shared between:
 - 1 Commissioning Sub-contractors (CSC): Employed by Trade Contractors for each system
 - 2 Specialist Equipment/Systems: Manufacturers or Agents employed by Trade Contractors
 - 3 BMS sub-contractor; Special designer and installer of the Building management systems
 - 4 Commissioning Management Specialist (CMS): Independent company employed by **Main Contractor** to programme, witness, and collate and prepare final documentation
- B The roles of the various parties indicated above are summarised in the following table and detailed in the following sub-clauses.

No	Activity	Trade Contractors and their Commissioning Sub-Contractor's Responsibilities	Commissioning Management Specialist's Responsibilities
1	Works Tests	Arrange Tests	Witnesses testing
2	Pre-commissioning	Carries out full scope of works	Checks and verifies that systems are ready for dynamic commissioning
3	Pressure testing, radiographic testing, flushing and preparation for setting to work.	Carries out Tests, and records results	Witnesses tests
4	Preparation, monitoring, reporting, revision and updating of a Commissioning Programme.	Assists in preparation by liaison with the Commissioning Management Specialist.	Prepares integrated Commissioning Programme.
5	Electrical Tests and functional demonstration of all systems	Tests and records all results	Re-tests 10% of all power and lighting circuits. Witnesses all electrical testing carried out by the Electrical Contractor and specialist contractors including BMS.
6	Execution of Commissioning Works	Carries out Testing, Balancing, Commissioning and Demonstrations and records results	Witnesses and collates all commissioning record information. Employs services of TDS to incorporate commissioning data into final Record documents.
7	Directing, programming witnessing and documenting of Manufacturer's /supplier's commissioning and "Integrated" testing and commissioning.	Provides for the specialist commissioning of main plant items and systems as specified elsewhere. Includes and participates in the integrated testing of systems where necessary to the requirements of the BMS and Fire Alarm specialist contractors under direction of CMS.	Directs and witnesses the integrated testing. Collates all specialist manufacturers commissioning record information. Employs services of TDS to incorporate commissioning data into final Record documents.
8	Fire Alarm Cause & Effect Demonstration	Fire Alarm sub-contractor Provides	Directs and witnesses t testing. Collates Fire

No	Activity	Trade Contractors and their Commissioning Sub-Contractor's Responsibilities	Commissioning Management Specialist's Responsibilities
		cause and effect matrix with assistance from trade contractors & demonstrates	Alarm sub-contractor's record sheets. Employs services of TDS to incorporate into O&Ms
9	Operating and Maintaining the plant to suit the needs of the Commissioning Contractor.	Provides all necessary attendance at times to suit the Commissioning sub-Contractors and CMS to operate the plant.	Agrees levels of Attendance necessary with Trade Contractors.
10	Preparation and submission for approval, to the CA of the Complete Record Drawings	Prepares, submits for approval and re-issues drawings to reflect the "as installed" systems	Reviews record drawings. Employs TDS to Collate final record drawings for incorporation into O&M Manuals
11	Preparation and submission for approval, Operating and Maintenance Manuals incorporating Commissioning Results and all other record documents	Assists and provides information for insertion into the manuals particularly manufacturer's O&M "information.	Employs TDS to prepare, submit for approval and complete the Operation and Maintenance Manuals
12	Preparation and submission for approval of Building Logbook, Building User Guide and Building Manual	Assists and provides information insertion into these record documents.	Employs TDS to prepare, submit for approval and complete these Record Documents
13	Provision of all necessary equipment, access towers, instruments etc for commissioning	Provides everything necessary	
14	Preparing Access Requirements in ceilings, floors etc	Prepares Requirements	Checks Requirements
15	Devising and installing a scheme of labelling valves, cables, etc. Identification for all dampers, pipelines,	Assists provides labels as devised by CMS and installs	Devises a scheme for labelling and plant identification
16	Devising and installing a scheme of labelling all Distribution Boards, cables socket outlets, smoke detectors, fire call points etc in conjunction with the Employer and the Engineer.	Assists, provides labels as devised by CMS and installs	Devises a scheme for labelling and plant identification
17	Provision of Instruction and	Provides instruction	Organises full courses

No	Activity	Trade Contractors and their Commissioning Sub-Contractor's Responsibilities	Commissioning Management Specialist's Responsibilities
	Training of the Employer's Personnel	and training by manufacturer's Specialist Agents	for attendance by Employers personnel and appropriate trade contractors and manufacturers
18	Preparation of Asset Register	Provide Schedules of all plant and equipment installed, suppliers and replacement intervals	TDS to incorporate into the O & M Manuals
19	Final adjustments and fine tuning of the installation	Provides everything necessary	Witnesses and accepts results
20	Post Occupancy period (8 weeks)	Assists in plant operation if necessary and remedies any defects	Monitors plant operation and identifies any defects.
21	Seasonal commissioning when systems not able to be fully demonstrated at Handover	Assists in plant operation if necessary and remedies any defects	Monitors plant operation and identifies any defects.

- C Refer also to Building Services specification section A which has a BSRIA schedule of activities and responsibilities for the designer, contractor and sub-contractors.

Y50.1.5 RESPONSIBILITIES OF THE COMMISSIONING MANAGEMENT SPECIALIST

- A **The Main Contractor** is to directly employ the services of an **independent** Commissioning Management Specialist to programme, supervise, integrate and witness the whole of the inspection, testing and commissioning of the Building Services installations. It is also the responsibility of the CMS to manage the handover and training of the employer's personnel, to employ the Technical Documentation Specialist and to take part in the post occupancy procedures. CMS to carry out the following at each stage:

- 1 **Pre-installation stage:**
 - a Check design stage drawings and review for suitability for commissioning and report findings
 - b Prepare a commissioning programme
- 2 **Installation Stage:**
 - a Review installation drawings for suitability for commissioning and ensure that previous comments/requirements have been incorporated
 - b plan, programme and witness the static testing of the installations and collate results
 - c Programmes, attends and witnesses any works tests.
 - d Witnesses static tests for all systems, including pipework ductwork and electrical services
Check that systems are ready for dynamic commissioning
- 3 **Commissioning Stage:**
 - a Plan and Programmes commissioning works
 - b Witness the commissioning of specialist systems by manufacturers/suppliers and collate results
 - c Witness testing and commissioning by Trade Contractors and their Commissioning Sub-contractors
 - d Collate commissioning results
 - e Carry out Independent checks for 10% electrical services and report results

- f Collate and review record drawings for accuracy. Return drawings to sub-contractor with comments to enable the drawings to be rectified by the sub-contractor.
- g Plan, programme and witness the integrated testing of the systems by various trade sub-contractors/specialists and collate results
- h Demonstrate commissioning and testing to the CA and report results
- i Chair commissioning meetings as necessary

4 Handover:

- a Review the Record Documents prepared by the Technical Documentation Specialist and return with any required corrections or additions.
- b Seek review and comments from the CA regarding the information in the, O& Manuals, Building Logbook, Building User Guide and Building Manual. Ensure that the TDS updates this record documentation to take account of these comments.
- c Record drawings: Review and comment on the sub-contractor's record drawings before they are submitted to the CA for review.
- d Training: Plan, programme and provide a scheme for training of the employer's personnel in the operation and maintenance of the plant and equipment. The services sub-contractors are to assist in this process and ensure that all specialist plant and equipment is demonstrated by the relevant manufacturer or his agent.

5 Post Occupation

- a Visit site weekly for a period of 8 weeks to meet with users and propose any necessary amendments to the systems if design parameters are not being achieved.
- b Seasonal Commissioning: When it is not possible to fully verify the commissioning of the systems provide for a return visit to site when the ambient conditions are appropriate to fully demonstrate the performance of the systems. BMS and building services contractors to assist.
- c Environmental Testing: In conjunction with the BMS sub-contractor set up suitably located sensors to monitor the internal conditions in representative areas of the building and provide weekly reports on the system performance for at least one year after handover. Should conditions not be achieved assist in providing solutions.

B Provide full-time personnel throughout the duration of the contract and part time after occupation to carry out the activities specified herein.

C Witnessing: Any systems or equipment which fail to meet the standards required are to be rectified by the services contractor and re-submitted to the CMS for further witnessing and testing until such time as the systems perform to the design requirements.

Y50.1.6 RESPONSIBILITIES OF THE TECHNICAL DOCUMENTATION SPECIALIST

A CMS is to employ a Technical Documentation Specialist (TDS) to prepare the following record documents using information provided and prepared by the building services sub-contractors and other relevant parties including the Employer, Commissioning sub-contractors, Trade contractors and the Commissioning Management specialist:

- 1 Building Logbook (if separate from Building Manual)
- 2 Building Manual
- 3 Building User Guide
- 4 Operation and Maintenance Manuals for the Building services installations.

B TDS is to provide record documents prior, and as a prerequisite, to practical completion to the satisfaction of the CA. Documents to be reviewed by the designers, main contractor and CMS. All comments to be incorporated between each submittal.

C Submit documents in accordance with the following schedule:

- 1 First Draft 1 month before practical completion
- 2 Final Draft 1 weeks before practical completion

Y50.1.7 RESPONSIBILITIES OF TRADE CONTRACTORS.

- A Each trade contractor is to install, test and fully commission his own installed works in accordance with this specification using the services of specialist Commissioning sub-contractor/s (CSC) **not the independent CMS (Commissioning Management Specialist)**. Demonstrate final commissioning to the CMS and CA or his appointed representative.
- B If any results are unacceptable to the CA/CMS the systems are to be rectified and retested until such time as they demonstrate compliance with the design requirements.
- C Where specialist systems or equipment are to be commissioned, employ the services of the manufacturer/specialist supplier to commission and test their respective systems or plant. Allow for demonstration/s to the CMS and repeat demonstrations until such time as the systems perform to the design requirements.
- D Co-operate and provide assistance to the BMS sub-contractor when undertaking the integrated testing and demonstration of the "as commissioned" installations which will involve a number of specialists or systems. Rectify any faults discovered during the integrated testing.
- E Provide full-time personnel throughout the duration of the contract and if necessary, after occupation to carry out the activities specified for the whole works.
- F Provide all necessary attendance to operate and maintain the plant and equipment during the commissioning/demonstration/training period as required to suit the needs of the CMS and if required during the 8-week period of post occupancy monitoring.
- G Note that each trade contractor is also responsible for:
 - 1 Preparation, submittal and correction of record drawings and BIM models developed in line with the MPDT. (refer to section B of this specification)
 - 2 Employing specialist manufacturer's or agents to demonstrate operation of plant and equipment during Employer's Training
 - 3 Provision of Technical Equipment Information for incorporation into the Operation and Maintenance manuals by the TDS
 - 4 Provision of an Asset Register for all plant and equipment which they have installed indicating:
 - a Make, model and performance details of equipment
 - b Original Order number
 - c Local Supplier or Agent, with contact details
 - d Plant replacement intervals
 - 5 Preparing the access requirements (generally in ceilings and floors) for future maintenance and commissioning.
 - 6 Provision of all equipment, access towers and instrumentation necessary for commissioning.

Y50.1.8 SUBMITTALS

- A CMS to submit the following for comment and review with regular updates when necessary:
 - 1 Pre-installation Review report
 - 2 Commissioning programme agreed with Main Contractor, Trade contractors and their CSCs
 - 3 Commissioning method statements agreed with main Contractor, Trade Contractors and their CSCs
 - 4 Testing and commissioning record sheets for all systems
 - 5 Collated final record drawings prepared by trade contractors (following checking for accuracy by CMS)
- B TDS to submit the following for comment and review according to the time schedule indicated.
 - 1 Building Logbook (if separate from Building Manual)
 - 2 Building Manual
 - 3 Building User Guide
 - 4 Operation and Maintenance Manuals for the Building services installations.
 - 5 Energy Performance Certificate

- C Trade Contractors and/or their appointed commissioning sub-contractors (CSCs) to submit the following for comment and review following witnessing by CMS.
- 1 All system static tests
 - 2 All system dynamic balancing and commissioning results
 - 3 All record drawings
 - 4 BIM models
 - 5 Asset Register of all plant and equipment
 - 6 COBie –UK-2012 schedules for all plant and equipment
 - 7 Technical information for incorporation into the O&M Manuals
 - 8 Access requirements for maintainability
- D BMS sub-contractor is to submit the following for review in accordance with section B and Y41 of this specification:
- 1 Control schematics
 - 2 Control panel wiring diagrams
 - 3 Detailed Description of Operation
 - 4 Points List schedule
 - 5 Integrated testing method statement
 - 6 Asset Register (BMS)
 - 7 COBie schedules (BMS)

Y50.1.9 QUALITY ASSURANCE

- A CMS and CSC are to base the work content and contract programme on the recommended procedures set out in the following documents (hereafter called the “Commissioning Documents”):
- 1 CIBSE Commissioning Codes:
 - a CIBSE Commissioning Code A: Air Distribution Systems
 - b CIBSE Commissioning Code B: Boilers
 - c CIBSE Commissioning Code C: Automatic Control
 - d CIBSE Commissioning Code L: Lighting
 - e CIBSE Commissioning Code M: Management
 - f CIBSE Commissioning Code R: Refrigeration systems
 - g CIBSE Commissioning Code W: Water Distribution Systems.
 - h CIBSE Metering Commissioning Code
 - 2 CIBSE Technical Memoranda:
 - a TM23: Testing Buildings for Air Leakage
 - b TM 31: Building Logbook.
 - 3 BSRIA Application Guides:
 - a AG1/98: Maintenance programme set-up
 - b AG11/92: Design for Maintainability
 - c AG16:2002 Variable flow water systems; design, installation and commissioning guidance
 - d AG17/2000: Achieving Minimum Outdoor Air – Commissioning and test procedures
 - e AG20/95: Commissioning of pipework systems – design considerations.
 - 4 BSRIA Building Applications Guides - BG:
 - a BG1/2007: Handover, O&M Manuals and Project Feedback – A toolkit for designers and contractors
 - b BG1 /2009: Building Services Job Book
 - c BG2/2004: Computer based Operation and Maintenance Manuals
 - d BG2:2010 Commissioning Water Systems
 - e BG4/2006: Airtightness Testing – The essential guide to Part L2 of the 2006 Building Regulations
 - f BG8:2009 Model Commissioning Plan
 - g BG11:2010 Commissioning Job Book – a framework for managing the commissioning process
 - BG 11/2010GLV: Commissioning Job Book Licensed version - multi-site

- BG 11/2010SLV: Commissioning Job Book Licensed version - single-site
 - h BG 12/2010: Floor void air tightness – air leakage specification
 - i BG 26/2011: Building Manuals and building user guides
 - j BG 29/2012: Pre-Commission Cleaning of Pipework Systems
 - k BG 44/2013: Seasonal Commissioning.
 - l BG 46/2013: Domestic Ventilation Systems
 - m BG 49/2015: Commissioning of Air Systems
 - n BG50/2013: Water Treatment for Closed Heating and Cooling Systems
 - o BG 65/2016: Floor Plenum Air Tightness – Guidance and Testing methodology
 - 5 BSRIA Technical Memoranda:
 - a TM1/88.1: Commissioning HVAC Systems – Guidance on the division of responsibilities.
 - 6 The Air Tightness Testing and Measurement Association ATTMA
 - a TSL2: Measuring air permeability of building envelopes (non-dwellings), Technical standard Level 2
- B BESA formerly HVCA Technical Reports:
- a TB/029: Site Pressure Testing of Pipework
 - b TR/6: Guide to good practice for site pressure testing of pipework
 - c TR/11: Guide to use of Plastic Pipework
 - d TR/19: Guide to good practice – Internal Cleanliness of Ventilation systems
 - e TR/20: Installation and testing of pipework systems (all parts)
 - f DW/143: Guide to Good Practice- Ductwork leakage testing.
- C Comply with all relevant British Standards and Codes of Practice referred to explicitly or implicitly for the works as a whole and in particular:
- 1 Those referenced in CIBSE Guides
 - 2 Those referenced in CIBSE Commissioning Codes and BSRIA Application Guides listed above
 - 3 BS 2971 - Specification for class II arc welding of carbon steel pipework for carrying fluids
 - 4 BS 5266 (all parts)- Emergency lighting. Code of practice for the Emergency Lighting of Premises
 - 5 BS 5306 (all parts) - Fire extinguishing installations and equipment on premises
 - 6 BS 6880-3 - Code of practice for low temperature hot water heating systems of output greater than 45kW installation, commissioning and maintenance
 - 7 BS 7671 + A3- Requirements for electrical installations - IET wiring regulations.
 - 8 BS 8558: Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Complementary guidance to BS EN 806
 - 9 BS EN 752 - Drain and sewer systems outside buildings
 - 10 BS EN 806-all parts - Specifications for installations inside buildings conveying water for human consumption. Installation
 - 11 BS EN 12056-5 - Gravity drainage systems inside buildings. Installation and testing, instructions for operation, maintenance and use
 - 12 BS EN 12170: Heating systems in buildings. Procedure for the preparation of documents for operation, maintenance and use. Heating systems requiring a trained operator
 - 13 BS EN 12171: Heating systems in buildings. Procedure for the preparation of documents for operation, maintenance and use. Heating systems not requiring a trained operator
 - 14 BS EN 12327: Gas infrastructure. Pressure testing, commissioning and decommissioning procedures. Functional requirements
 - 15 BS EN 12845: - Fixed fire-fighting systems. Automatic sprinkler systems. Design, installation and maintenance.
 - 16 BS EN 14336: Heating Systems in Building – Installation and commissioning of water-based heating systems
 - 17 IGE/UP/1: Strength/tightness Testing and direct purging
 - 18 IGEM/UP/1A: Strength /tightness testing and direct purging (small I&C)
- D Comply with manufacturer's instructions when setting plant and equipment to work.
- E Qualifications: Commissioning Management Specialist and Commissioning sub-contractors are to be members of the Commissioning Specialists Association

Y50.2 PART 2 – SCOPE OF WORKS FOR TESTING AND COMMISSIONING

Y50.2.1 PRE-INSTALLATION STAGE

- A CMS to review the design drawings prior to installation to ensure that sufficient plant/equipment and facilities are provided to enable commissioning to be adequately carried out. CMS to ensure that sufficient valves, test points, dampers etc. are incorporated and correctly located to allow satisfactory testing, regulating and commissioning. Design drawings to be updated to incorporate any required changes.
- B Within 2 weeks of appointment the CMS is to provide a commissioning programme, for agreement with the main contractor. The programme is to indicate the various activities and associated time periods required for the commissioning of the services. Agree this programme with the CA and other relevant parties for incorporation into the main contract programme.
- C CMS to take into account the main contract programme and identify:
- 1 The following periods:
 - a Pre-commissioning of air and water systems and electrical systems
 - b Power on date
 - c Dynamic commissioning
 - d Integrated systems testing and commissioning
 - e Performance demonstrations and witnessing
 - f Handover and employer's training.
 - 2 The following for each system:
 - a Earliest and latest start date
 - b Finish date
 - c Duration to complete task (in days).
 - 3 The following milestones:
 - a Completion of static tests (pipework, ductwork and electrical tests)
 - b Period required for dynamic testing (balancing and integrated tests)
 - c Power on to the MCCs
 - d Integrated testing and commissioning particularly:
 - BMS installations
 - Fire Alarm and Detection Systems
 - Life Safety Systems
 - e Heat on to the building
 - f Cooling on to the building
 - g Demonstration to the CA
 - h Submittals required to show building regulation compliance
 - i Employers training
 - j Practical completion.
 - 4 Ensure that all systems are shown separately and not grouped together, e.g. "MCPs" is not acceptable but "MCP-01-1", "MCP-01-02", etc. would be acceptable
 - 5 For larger projects identify commissioning zones so that phased commissioning may be carried out in stages and identify the periods required for each zone.
 - 6 Each system to be separately identified and all interdependencies to be shown
 - 7 Indicate the period required for the fully integrated testing of the systems to demonstrate that all systems interact with each other in the correct manner. This is particularly relevant to fire alarm, BMS and any life safety items with hard-wired interlocks.
- D CMS is to submit proposed testing and commissioning record sheets to the CA for comment. Agree information and sheets to be used with the CA prior to their first use by the CSCs.

Y50.2.2 INSTALLATION STAGE

- A Within 28 days of appointment, CMS to provide method statements, agreed with relevant CSCs, for each system and sub-system listing all the activities in complete detail for comment and approval by the CA.

- 1 Identify the following:
 - a Specific details of the task
 - b Responsibilities of each party
 - c Any pre-requisites or milestones
 - d Interfaces with other systems
 - e Documentation proposed
 - f Health and safety considerations
 - g Demonstration procedures.
 - 2 No commissioning is to take place without an approved method statement being in place.
- B CMS and CSCs to review the installation drawings to ensure that all provisions for commissioning are included in the installation drawings prior to being sent to the CA for review. Building services sub-contractor to re-submit drawings when rectified.
- C During the installation ensure that all static tests are carried out by the relevant contractors with witnessing by the CMS where indicated.
- 1 CSC appointed by the mechanical services subcontractor to carry out and record the following with witnessing by the CMS where indicated:
 - a all pipework pressure tests, CMS to witness
 - b all ductwork pressure tests, CMS to witness
 - 2 CSC appointed by Electrical services subcontractor to carry out and record all electrical tests in accordance with the specification
 - 3 CSCs for each specialist system to carry out all static tests and record results. CMS to witness.
 - 4 CMS to collate all approved/compliant tests for approval and then incorporation into the O&M manuals by TDS.
- D Any plant or equipment that fails to meet the specified performance requirements must be satisfactorily re-tested or replaced by the installation contractor.
- E Prior to dynamic commissioning of the water systems CSC is to ensure that all water systems have been properly cleaned, flushed, filled and vented by the installation contractor.
- F Prior to dynamic commissioning of the air systems CSC is to ensure that all air distribution systems have been properly cleaned and checked by the installation contractor. Refer to U80.

Y50.2.3 COMMISSIONING STAGE

- A CSCs to commission their respective works in accordance with the commissioning programme together with witnessing and acceptance by the CMS.
- B CMS to carry out a major review with the building services trade contractors and their CSCs and update the commissioning network at monthly intervals. If necessary, revise and amend the programme to suit the progress of the works. Copies of the programme and network analysis together with any revisions shall be issued to the CA for comment.
- C CMS to independently retest 10% of the static electrical tests on all power and lighting circuits. Should the tests indicate an unacceptable level of error the whole system shall be rectified and re-tested by the installing contractor.
- D During the installation ensure that all dynamic tests are carried out by the relevant contractors with witnessing by the CMS.
- a CSC to carry out dynamic commissioning of air systems including balancing and proving compliance with the specified air volume flow rates at each outlet or inlet. CMS to witness
 - b CSC to carry out dynamic commissioning of water systems including balancing and proving compliance with the specified water flow rates and temperatures at each terminal unit or outlet. CMS to witness
 - c CSC to co-ordinate and witness any specialist commissioning of systems or plant by manufacturer's agents. CMS to witness all specialist commissioning.

- d CMS to collate all approved/compliant tests for incorporation into the O&M manuals by TDS.
- E CMS & CSC to witness and accept the commissioning of all specialist systems by the manufacturers / suppliers (employed by the building services trade sub-contractors) including, but not limited to the following:
 - 1 Controls
 - 2 Fire Alarm Installation
 - 3 Emergency Lighting systems
- F Specialist services sub-contractors are required to record information on agreed documentation and submit to the CA for comment and review.
- G CMS to collate all approved testing and commissioning records for inclusion in the O&M manuals by TDS.
- H CMS & CSC to demonstrate, to the satisfaction of the CA, that the systems are properly regulated and set to work.
- I CMS is to set up a scheme in conjunction with the CSC for proving that systems are properly integrated and controlled when working together including:
 - 1 Fire Alarm and Detection systems: Liaise with the Fire Alarm specialist installer to ensure that:
 - a All detectors, etc. are properly adjusted and calibrated
 - b All cause & effect functions are achieved.
 - c All systems operate to their design intent including all safety, alarm and interface scenarios.
- J TDS to prepare the "Draft" and "Final" Operating and Maintenance manuals prior to practical completion including review of the Record Drawings prepared by others.
- K Building service sub-contractors to prepare the final plant and Asset Register for incorporation into the O&M Manuals.

Y50.2.4 CO-ORDINATION

- A Co-ordinate the commissioning works with the works of others and assist as necessary.
- B Indicate on the drawings where access is required into ceiling voids and partitions and ensure that these points are available at the start of the commissioning works and are not closed up until the commissioning works are complete.

Y50.2.5 RECORD DOCUMENTS

- A TDS to obtain, collate and incorporate all the information provided by the Trade Contractor into the "Record Documents". The manuals are to be in the form of electronic manuals with hyperlinks to drawings, manufacturer's information and commissioning results.
- B Prepare the record documents and O&M manuals in accordance with the following standards where applicable:
 - 1 BS EN 12170 - Heating systems in buildings. Procedure for the preparation of documents for operation, maintenance and use. Heating systems requiring a trained operator
 - 2 BS EN 12171 - Heating systems in buildings. Procedure for the preparation of documents for operation, maintenance and use. Heating systems not requiring a trained operator.
 - 3 CIBSE Technical Memoranda:
 - a TM 31: Building Logbook.
 - 4 BSRIA Application Guides:
 - a AG1/98: Maintenance programme set-up
 - b AG11/92: Design for Maintainability
 - 5 BSRIA Building Applications Guides - BG:
 - a BG1/2007: Handover, O&M Manuals and Project Feedback – A toolkit for designers and contractors

- b BG1 /2009: Building Services Job Book
- c BG2/2004: Computer based Operation and Maintenance Manuals
- d BG 26/2011: Building Manuals and building user guides

C Submit the following record documents to the CA for comment as follows:

- 1 Building Logbook (if separate from Building Manual)
- 2 Building Manual (may contain Building Logbook)
- 3 Building User Guide
- 4 Operation and Maintenance Manuals for the Building services installations.
- 5 Asset Register of all plant and equipment (may be within O&M Manuals)
- 6 As installed Energy Performance Certificate (within Logbook)

D **Building Logbook:** The log books are to contain the following with input from design team where necessary:

- 1 Description of key responsibilities.
- 2 Schedule of contacts.
- 3 Description of the overall building, including zoning and occupancy.
- 4 Description of the building's operational strategy.
- 5 Description of the building's services plant, controls and management systems.
- 6 Changes that have been made to the building. (if existing building)
- 7 Health and safety considerations.
- 8 Maintenance requirements. (key features refer to O&M manuals for details)
- 9 Metering and monitoring strategy.
- 10 Calculation of TER (target CO₂ emission rates)
- 11 Calculation of BER (building CO₂ emission rates)
- 12 Provision of the Construction Energy Performance Certificate.
- 13 Building performance in use investigations and targets.
- 14 References to other documents.

E **Building Manual:** This document should not take the place of the O&M manuals. This is intended to be a concise operator's guide to the building. The additional information required for the Building Manual is a concise summary of the following information and should be prepared using the templates of BSRIA – BG2011 Building Manuals and User Guides.

- 1 Building Information
 - a Building Construction Details
 - b Basic Building Information
 - c Legal ownership information
 - d Multi-tenant occupier List
 - e Building Activities
 - f Building measurements
 - g Building plans/layouts
 - h Building Envelope information
 - i Mechanical Building Services description
 - j Control system information
 - k Electrical services description
 - l Public health Services description
 - m Specialist Building Services
 - n Maintenance Strategy and History
 - o Maintenance History log
 - p Statutory inspections
 - q Written Scheme of Examination for pressure systems
- 2 Emergency Information
 - a Building Criticality Rating
 - b Emergency procedure for a water leak
 - c Utility isolation

- 3 Building Utility and Environmental Information
 - a Energy and Environmental Policies
 - b Utility provider details
 - c Annual Building Energy Consumption
 - d Energy conservation
 - e Refrigerants and F gases
- 4 Water Management
 - a Water Strategies
 - b Leak Detection
- 5 Materials and Waste management
- 6 Transport Facilities
- 7 Refit and Rearrangement Considerations
 - a Key design and operational issues
 - b Key design Information
 - c Handover Information
 - d Major changes to building services
- 8 Reporting Provision
 - a Building contacts
 - b Operating Hours
 - c Health and safety issues
 - d Standard operating procedures
- 9 Training
 - a Compulsory training
 - b Additional training

F Building User Guide: Provide the end users/occupants of the building with a simple, quick and easy guide to the everyday functions of the building, in order to ensure a safe and healthy work environment while complementing the efficient operation of the building to the full potential provided by the design. Prepare the User Guide in line with BSRIA templates within BG 26/2011 Building Manual and User Guides. The user Guide should contain the following information from the building users' perspective and much of this information will need to be obtained from the Employer:

- 1 Building Information
 - a General
 - b Building Environment (heating & cooling and ventilation and controls)
 - c Lifts and Escalators
 - d Security System
- 2 Emergency Information
 - a Fire response and alarm system
 - b Fire evacuation procedure
 - c First Aid
- 3 Building Utility and Environmental Information
 - a Overview of Company Policy and practices
 - b Energy and Environmental Strategy
 - c Annual Building energy consumption
 - d Energy Conservation
 - e Mechanical services description
 - f Electrical services description
 - g Communications description
- 4 Water Management
 - a Water Strategy
 - b Domestic Water
- 5 Materials & Waste management
 - a Materials purchasing Policy
 - b Waste management policy
- 6 Transport facilities

- a Transport
 - b Parking
- 7 Refit and Rearrangement Considerations
 - a Reporting procedures
 - b Responsible parties
- 8 Training
 - a Compulsory training
 - b Additional training

Y50.2.6 OPERATING AND MAINTENANCE MANUALS

- A The Technical Documentation Specialist (TDS) employed by the Commissioning Management Specialist is to provide Operating and Maintenance Manuals as described in this section. The TDS is responsible for collating all relevant information for inclusion in the manuals.
- B Comply fully with the requirements of BSRIA Document BG1/2007 and BG2/2004 and the provisions required in this section.
- C Provide separate Operation and Maintenance Manuals for each complete phase or stage of the works prior to handover to the client.
- D The manuals are to be in electronic format with hyperlinks to drawings, commissioning results and manufacturers information.
- E The manuals are to cover all the mechanical and electrical services in the building including, BMS systems, Fire Alarm, Fire protection, PA, security etc.
- F The manuals are to cover not only the new plant and equipment but also any modifications to existing systems. The information shall describe the complete Building Services systems including:
 - 1 Heating Systems
 - 2 Chilled Water systems
 - 3 Heat rejection systems
 - 4 Air handling systems
 - 5 Water treatment
 - 6 Controls/BMS system
 - 7 Condenser water systems
 - 8 Swimming pool systems
 - 9 Lighting
 - 10 Emergency Lighting
 - 11 Fire Alarms
 - 12 Fire Protection Systems
 - 13 Fireman's Controls
 - 14 Power Distribution
 - 15 Lightning Protection
 - 16 Sanitary and Waste Disposal Systems
 - 17 Hot and Cold Water
 - 18 Emergency Generation
 - 19 Emergency Lighting
 - 20 Earthing Systems.
 - 21 Access Control System
 - 22 Security systems
 - 23 Voice Alarm/Public Address System
 - 24 Intruder Detection System
 - 25 Turnstiles and Turnstile Monitoring system
 - 26 CCTV system
 - 27 Generator Systems
 - 28 Emergency Lighting systems

- 29 UPS Systems
- 30 Vertical Transportation
- 31 Window Cleaning Systems
- 32 HV/LV Switchgear
- 33 Sprinkler & Fire Protection systems
- 34 Car Park Ventilation System
- 35 Water features equipment
- 36 Waste disposal and compaction equipment
- 37 Window Blind controls.

G The manuals shall be designed to be:

- 1 A guide to the establishment of safe operating procedures
- 2 An aid to the clear and concise understanding of the individual systems
- 3 A reference to the physical location and identification of plant and equipment, together with selected control equipment
- 4 A training aid to facilitate the instruction of Operating Staff
- 5 A comprehensive reference document for maintaining the total systems.

H Operation and Maintenance Manuals: The first draft is to contain the main outlines of the document, with contents, chapter headings, volume numbers and make up. At this stage it should include maintenance procedures, draft manufacturer's information, and lists of record drawings. It will not contain commissioning and testing results except for copies of standard sheets that are to be used. It will not contain record drawings.

I The second Draft is to incorporate comments received from the first Draft and will be largely complete except for any outstanding commissioning records. It will include detailed manufacturing information and all record drawings.

J The final draft is to incorporate the comments received from the second draft and will be essentially complete except for any final commissioning results.

K Submit two copies of each draft to the CA one of which will be returned with comments.

Issue three hard copies and one electronic version of the Record Documents at Practical Completion of any stage or phase of the works. At this stage the Record Documents are to be fully comprehensive and incorporate any further comments received including the documentation of the testing and commissioning results and the record drawings. One copy of the record documents will be retained by the CA.

Y50.2.7 CONTENT OF OPERATING AND MAINTENANCE MANUALS

A Ensure the O&M manuals for each discipline follow the same general format and together provide a 'site specific' set of documents.

B Ensure the O&M manuals are produced in a timely manner for use during the Employer's training and of a suitable standard for comment.

C The O&M Manual must be produced in the following format, as described in BSRIA, Application Guide /BG1/2007 & BG2/2004 operating and maintenance manuals for building services installations)

- 1 Section One: How to Use the Manual:
 - a This initial section is a guide to the contents, structure and layout of the manual. It enables the reader to comprehend the scope and purpose of the document and to identify readily where specific information can be obtained.
- 2 Section Two: Contractual and Legal Guides:
 - a The contractual and legal records of the installation should include (if applicable):
 - the name and address of the installation

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- details of ownership, leases etc
 - details of local and public authority consents
 - details of the design teams, consultants, installation contractors and associated sub-contractors
 - dates for the start of the installation, for handover (practical completion) and for the expiry of the defects liability period
 - information on all guarantees affecting components, systems and plant items, together with expiry dates and names, addresses and telephone numbers of relevant contacts.
- b For each item of plant and equipment installed within the building and contained in the list of services covered by the O&M Manual, copies of the following documents should also be provided, where applicable:
- test certificates
 - manufacturers' guarantees and warranties
 - insurance inspection reports
 - safety and fire certificates.
- 3 A clear statement should be made in this section concerning those hazards and safety precautions of which the operators and maintainers of the installations need to be made aware. This should include the following:
- a any known feature or operational characteristic of the equipment or systems installed which may produce a hazard
 - b any known hazards against which protection can be provided
 - c any mandatory requirements relating to safety
 - d any other safety precautions which should be observed
 - e any other relevant warnings.

D Section Three: Overall Purpose

- 1 This section provides a general overview of the original design intent (available in outline from the design brief and in detail from the specification). It should include a summary for each engineering system installed giving:
- a the parameters and conditions within which it has been designed to operate, including known hazards
 - b the type of each service (gas, electricity, water etc) required to operate the system
 - c the intended method of control
 - d The section should be kept as brief as possible.

E Section Four: System Descriptions:

- 1 This provides a detailed description of each engineering system installed. It should include:
- a the system type (e.g. cold-water supply)
 - b system location and what it serves
 - c what the system depends upon in order to function
 - d design data, basic design parameters, basic assumptions made during design
 - e reasons for selecting particular plant
 - f expected service life (where available)
 - g planned operational efficiency.

F Section Five: Asset Register Schedules:

- 1 The type, model number and serial number of all component items within the system should be listed, together with the names of their respective manufacturers or suppliers.
- 2 COBie-UK-2012 tables for information exchange 6

G Section Six: Parts Identification and Recommended Spares:

- 1 This should comprise a parts identification list detailing and identifying replaceable assemblies, sub-assemblies and components. It should include suppliers' recommendations for both spares and 'running spares' (i.e. parts required for scheduled replacement due to wear or deterioration)
- 2 Items normally held in stock by a supplier, or for which a refurbishment service is available should be identified separately.

H Section Seven

- 1 Spares Policy: This section should offer a guide to the setting up of a spares facility including recommended stocking levels. It should be prepared after consultation with the occupier regarding the consequences of failure and the period of downtime which is acceptable. It should also take into account suppliers' recommendations as given above
- 2 Again, those items normally held in stock by a supplier or for which a refurbishment service is available should be clearly identified.

I Section Eight: Commissioning Data: Record the results of all commissioning work and associated tests. This should include:

- 1 measured data
- 2 measurement points
- 3 test equipment used
- 4 calibration certificate details
- 5 a statement of whether design requirements were achieved.

J Section Nine: Operation Instructions

- 1 Provide instructions for the safe and efficient operation, under both normal and emergency conditions, of each engineering system installed. These will be in addition to manufacturers' literature for plant items and should include:
 - a a recommended strategy for operation and control
 - b an outline of the general operating mode
 - c control data (location, effect, object, sequence, limits of capability, modes, set points)
 - d procedures and sequences for start-up, running and shutdown, under both normal and emergency conditions
 - e interlocks between plant items
 - f operating procedures for stand-by plant
 - g precautions necessary to overcome known hazards
 - h the means by which any potentially hazardous plant may be made safe
 - i target figures for both energy consumption and energy costs
 - j forms for recording plant running hours, energy consumption and energy costs.

K Section Ten: Maintenance including Planned Preventative maintenance

- 1 Maintenance Instructions: The manufacturer's recommendations and instructions for maintenance must be detailed for each item of plant and equipment installed. Clear distinction should be made between planned tasks (preventative maintenance) and work done on a corrective basis. Instructions should be given on each of the following, as appropriate:
 - a the isolation and return to service of plant and equipment
 - b adjustments, calibration and testing
 - c dismantling and re-assembly
 - d the exchange of components and assemblies
 - e dealing with hazards which may arise during maintenance
 - f the nature of deterioration and the defects to be looked for
 - g special tools, test equipment and ancillary services.
- 2 Planned Preventative Maintenance Schedules: Maintenance schedules should be provided for all the preventive maintenance tasks identified above. These should be based on both manufacturers' recommendations and other authoritative sources (e.g. statutory or mandatory requirements) and should include:
 - a inspections
 - b examinations
 - c tests
 - d adjustments
 - e calibration
 - f lubrication

- g periodic overhaul.
- 3 The frequency of each task may be expressed as specific time intervals, running hours or completed operations, as appropriate. Collectively, the schedules will form a complete maintenance cycle, repeated throughout the working life of the installation.
- 4 The source of the schedules should be stated
- 5 Necessary periodic inspections and tests for insurance, local authority or supply authority purposes should be separately identified.
- 6 Fault Finding
 - a Procedures for the logical diagnosis and correction of faults should be provided.
- 7 Lubrication:
 - a A schedule of all plant requiring lubrication should be provided together with manufacturers' recommendations on the type of lubricant and the method and frequency of application.
 - b Where the type of lubricant is identified by product name, a generic reference (e.g. British Standard) should also be given. Information must also be provided on special requirements for the handling and storage of lubricants.

L Section Eleven: Modification Information:

- 1 Modifications are authorised changes which may affect the safety, reliability, operation or maintenance of a system or any of its components.
- 2 Information on permitted plant or system modifications allowed for by manufacturers or system designers should be included for each system. Space must be provided in the manual for the recording of all modifications and changes as they occur (this would initially comprise a series of appropriately headed blank pages). Furthermore, it is essential that a procedure is devised and incorporated to ensure that all modifications are noted in every copy of the manual, where it is located.

M Section Twelve: Disposal Instructions:

- 1 Where relevant, information should be provided detailing:
 - a any known dangers likely to arise during the disposal of specific items of plant or equipment together with the necessary precautions and safety measures
 - b methods for safely disposing of or destroying the equipment or any parts thereof, including packaging, insulation and fluids
 - c sources from which further advice can be obtained.

N Section Thirteen: Names and Addresses of Manufacturers:

- 1 Details of manufacturers and suppliers of equipment listed in the manual should be provided under this heading giving name, address, telephone number and telex/fax number. Any additional information likely to help the building operator make contact with or obtain advice from a manufacturer or supplier should also be included
- 2 Where appropriate, details of local stockists of spare parts, replaceable assemblies or complete units should also be provided
- 3 Details should be arranged in alphabetical order of manufacturer or supplier name to provide a logical information retrieval procedure.

O Section Fourteen: Record Drawings:

- 1 An index should be provided of all 'Record' drawings supplied during the course of the installation work, identified by number and title (complete with drawing in CAD format)
- 2 The index should also include a schedule of all drawings issued by manufacturers and suppliers during the course of the installation work, e.g. control panel wiring diagrams.
- 3 One set of A3 record drawings (Electronic version with pdfs)

P Section Fifteen: Emergency Information:

- 1 An important feature of any manual is the emergency information. Located, for ease of reference, at the end of the document, this should include names, addresses, telephone and telex/fax numbers of the appropriate contacts in the event of fire, theft or burglary, and gas, electricity or water failure/leaks. It

should also list those firms or staff to contact in the event of the failure or breakdown of such plant as lifts, boilers or pumps

- 2 Where applicable, the location of fire-fighting equipment, hydrants and rising mains should be described
- 3 Special attention should be given to hazards particular to the building
- 4 Depending on client policy, a note of security installations may also be included.

Q Section Sixteen: Manufacturers' Literature:

- 1 A complete set of all manufacturers' literature should be provided for the plant and equipment installed and assembled for each building services system
- 2 This literature should provide the following information
- 3 description of the product as purchased
- 4 the cost and date of purchase
- 5 performance – behavioural characteristics of the equipment in use
- 6 applications – suitability for use
- 7 operation and maintenance details
- 8 resources of labour, plant, material and space required
- 9 methods of operation and control
- 10 cleaning and maintenance requirements
- 11 protective measures
- 12 labour safety and welfare associated with the equipment
- 13 public safety considerations.
 - a Where this data is not adequately provided in manufacturers' literature, the manual author should augment the literature as necessary.

R Provide an electronic version of the O&M Manual on flash storage device.

- 1 All information contained within the O&M manual must be produced in electronic format (including manufacturers' literature, test certificates, commissioning data, drawings etc .pdf versions are acceptable)
- 2 Documents and schedules are to be produced in the latest versions of Microsoft Word (schedules, tables and commissioning/test results are to be produced in Excel)
- 3 Manufacturers' literature, test certificates, COSHH data sheets, images and diagrams etc., must be electronically scanned to a minimum resolution of 720n x 720 dpi at full size
- 4 Colour originals are to be scanned at a setting of 16 million colours
- 5 Black and white images are to be scanned at a setting of 256 greyscales
- 6 All record drawings in pdf format
- 7 Electronic 'hyper links' must be provided throughout the O&M Manual:
 - a The 'hyperlinks' must comprise of linking to each main section of the O&M Manual, with further linking to each sub-section
 - b 'Hyper links' must also be provided to all scanned documents and record drawings (linked from the schedule at the front of that particular section)
 - c The 'style' of 'hyper links' and their full extent, to be agreed with the client
 - d The contractor must make full allowance for all works involved with the 'hyperlinks' within the O&M Manual.
- 8 Provide a menu driven 'search engine' within the O&M Manual which can easily locate specific information.

Y50.2.8 COLLATION OF RECORD DRAWINGS FOR O&M MANUALS

- A As Installed (Record) drawings of all the Services installations are to be provided by the Services Trade Contractors on completion of the contract works.
- B Record drawings of the final "as-installed" layouts are to be issued, by the services contractors, in draft form to the CMS for approval prior to the Testing and Commissioning period to allow for checking the accuracy.

The services contractors must revise the drawings as necessary (incorporating any CMS requirements) and then issue the drawings at least 1 month prior to practical completion of any stage or phase of the works.

- C CMS is responsible for collating all the record drawings prepared by others and issuing them for approval after any CMS comments/corrections have been attended to by the installation contractors.
- D Record drawings are to include manufacturers drawings for all items of plant, control panels and wiring diagrams, BMS drawings, specialist installations together with the services contractors' co-ordinated updated installation drawings.
- E CMS to issue at practical completion the complete finalised set of record drawings made up of USB flash drive/memory stick, and 3 sets of white full-size prints for each drawing. One set of A3 drawings is to be incorporated into the Operation and Maintenance manuals by TDS. The drawings and disks are to be provided by the services contractors.

Y50.2.9 EMPLOYERS TRAINING

- A CMS is to devise and implement a scheme for the training of the Employer's operation and maintenance staff. Trade sub-contractors are to employ the services of their specialist plant/system manufacturers to assist in this process. Specialist training to be provided for the following systems:
 - 1 Control
 - 2 Fire Alarm & detection
- B Draft proposals of the Scheme content shall be submitted to the CA for approval not less than 1 months prior to practical completion of any stage or phase of the works.
- C Familiarisation training during installation: Arrange access to the site for the Employer's personnel, up to 6 people to familiarize themselves with the installation prior to practical completion. With the aid of the trade sub-Contractors and their commissioning sub-contractors demonstrate the following:
 - 1 main plant items and locations
 - 2 isolation valves, sprinkler control valves
 - 3 fire pumps
 - 4 switchboards
 - 5 MCPs
 - 6 commissioning stations
 - 7 drains and test points and the like.
 - 8 This work to commence immediately after the first fix installation and prior to the services being concealed in false ceilings or under raised floors.
- D Formal instruction: Provide a period of formal instruction commencing 4 weeks before practical completion of any stage or phase of the works. It is envisaged that the training session will take at least 3 working days as minimum. This session is to comprise a period of formal classroom instruction on the systems and their operation. Include the following for each system:
 - 1 Operation under normal conditions
 - 2 Fault conditions
 - 3 Risks and hazards associated with each system
 - 4 System adjustment.
- E Field demonstration:
 - 1 Demonstrate the major plant items for each system in their actual location.
 - 2 Demonstrate the operation of the BMS system including:
 - a System graphics
 - b Set points
 - c Fault conditions
 - d Response to various types of alarms

e Energy monitoring systems

F At the end of this period the employer's staff should be able to:

- 1 Know the purpose of each item of equipment
- 2 Understand the control set points
- 3 Make system adjustments
- 4 Understand and respond to fault indications
- 5 Be familiar with planned preventative maintenance for all plant items
- 6 Understand how to isolate plant and equipment safely
- 7 Understand how to get plant and systems operational.
- 8 How to set up and monitor energy usage

G Where parts of the buildings are handed over prior to the full completion. Individual training sessions will be required for each stage or phase of the works.

Y50.2.10 IDENTIFICATION AND LABELLING

- A CMS is to provide a scheme for the identification and labelling of all plant and equipment. Preferably this should follow the design drawings unless there is an overriding need for change.
- B Submit the scheme details to the CA for comment and review.
- C Labels are to be supplied and installed by their respective services contractors. Refer to Y32.

Y50.2.11 POST OCCUPANCY ATTENDANCE

- A Where indicated in section A of this specification CSM and Controls sub-contractor are to provide for a weekly visit to site for a period of 8 weeks after handover to monitor the performance of the systems with the end users/occupiers.
- B Recommend any adjustments necessary if systems do not achieve the required conditions.

Y50.3 PART 3 – TESTING PROCEDURES

Y50.3.1 TESTING GENERAL

- A The Services (Mechanical, Electrical and Plumbing) Sub-Contractors are responsible for testing their complete installations and for ensuring that they are in a satisfactory condition for dynamic commissioning by their Commissioning Sub-Contractors.
- B The MEP Sub-Contractors are required to offer each system to their Commissioning sub-contractors (CSC) prior to dynamic commissioning. When the installation has been accepted as tested and complete the Commissioning Sub-Contractors may then commence the regulation, balancing and setting to work of each system.
- C In the same manner the building itself must be in a satisfactory state to enable commissioning to take place. The Contractor is required to ensure that all building works are complete prior to the dynamic commissioning of any of the air systems.

Y50.3.2 PIPEWORK SYSTEMS STATIC TESTING

- A Pressure testing of water carrying pipework systems to be carried out in accordance with the following standards where appropriate:
 - 1 BSRIA/AG20/95
 - 2 BSRIA/BG 29/2012
 - 3 BS 6880-3
 - 4 BESA/HVCA TR/20 all Parts
 - 5 BS EN 806-4
 - 6 BS 8558
- B Testing procedures for pipework installations:
 - 1 hydraulically test after erection and before insulation is applied.
 - a For welded mains: Every weld to be hammered while under pressure and the test period may be prolonged to allow for this action being performed.
 - b Tests may be in sections as work proceeds.
 - c Pipework installations includes valves, heat exchangers and controls etc that are subject to the system pressure when in operation.
 - 2 Test pressures for working pressures:
 - a $\leq 280\text{Pa}$: twice the working pressure
 - b $> 280\text{Pa}$: $1\frac{1}{2}$ times the working pressure plus 140 kPa.
 - 3 Test pressure to be maintained for a minimum of 2 hours without loss of pressure or visible evidence of leakage.
 - 4 Equipment for testing: Use a test pump assembly with a sealing valve and associated test gauges.
 - a Disconnect the pump from the system on reaching test pressure at which time the test period shall then begin.
 - b Monitored the test pressure on the test gauge associated with the sealing valve pump assembly unit.
 - c Test gauge: 150mm diameter
- C Where insulation must be installed before the completion of the entire system it may become necessary to test in sections. Make due allowance for this by plugging off certain sections as necessary, in order that pressure testing can be carried out prior to application of thermal insulation.

Y50.3.3 INTERNAL DRAINAGE SYSTEMS TESTING

- A Test in accordance with the recommendations laid out in BS EN 12056-5 and Building Regulations approved document part H.

- B Test the complete above ground installation to the satisfaction and in the presence of the Environmental Health/Building Control Officer and witnessed by the Commissioning Management Specialist. The test to comprise:
- 1 Checking that all sections of installation are securely fixed and free from obstruction and debris.
 - 2 Carry out Air test as follows:
 - a Temporarily plug or cap off outlets.
 - b Inspect the system for leaks
 - c Pump air into the system, one floor at a time, through a branch of a tee until a pressure equal to 38mm water gauge is achieved.
 - d Close the inlet valve and allow a period of temperature stabilisation, after which pressure to be maintained, without loss, for not less than 3 minutes
 - e Every water trap should maintain a seal of at least 25mm
 - 3 After testing, locate and remedy all defects without delay and retest as instructed. Do not use smoke to trace leaks.
 - 4 Provide Test Certificates to show that equipment and materials and installations have been tested in accordance with the specified requirements. Provide and sign the test certificate witnessed by the CSM to indicate:
 - a the apparatus/service under test,
 - b test pressure.
 - c duration.
- Note: Generalised descriptions of the area tested will be rejected.
- C Siphonage and Back Pressure Tests: Test WC pans by flushing and test other appliances by filling to overflow level, then removing the plug.
- 1 Carry out tests at least three times with traps recharged before each test
 - 2 Test each appliance individually for self-siphonage,
 - 3 then test for induced siphonage and back pressure by discharging appliances simultaneously on each stack.

Y50.3.4 DUCTWORK SYSTEMS TESTING

- A Pressure test the complete air distribution, extract and exhaust systems as a whole or as installation proceeds as stated herein in accordance with HVCA DW 144 Appendix A Section 6. This applies to all ductwork systems including low and medium velocity. Comply with the procedures of HVCA DW 143.
- B All tests to be witnessed by the Commissioning Management Specialist. Submit the records of all tests for approval by the CA upon satisfactory completion of the tests.
- C Carry out the tests prior to thermal and/or acoustic insulation being applied to the ductwork.
- D Submit the following particulars with each test record:
- 1 Description and location of section under test
 - 2 Length of ductwork section under test and surface area of ductwork
 - 3 Period of test (minutes)
 - 4 Static pressure held during test
 - 5 Pressure drop measured across orifice plate (or other measuring device)
 - 6 Leakage rate (l/s) allowable and obtained under test
 - 7 Leakage rate (percentage)
 - 8 Calibration data for measuring device.
- E Should any test indicate leakage rates in excess of that laid down in HVCA DW 144, that section of ductwork is to be dismantled, cleaned-down and re-assembled and the tests repeated.
- F If substantial leaks are detected, even though the overall leakage is within the above rates, repair the faulty joints and repeat the test. To assist in locating faulty joints smoke or bubble testing may be used.

- G Take care to ensure that the ductwork is not exposed to excess pressure whilst under test which might cause deformation or joint breakage.

Y50.3.5 ELECTRICAL SYSTEMS TESTING

- A Carry out a visual inspection prior to any electrical testing as detailed in IET Regulations (17th Edition) Chapter 61.
- B Check the following elements in accordance with IET regulations:
- 1 Connection of all conductors are complete
 - 2 The correct identification of all conductors has been completed
 - 3 The specified conductors of current carrying capacity and voltage drop have been installed
 - 4 The connection of single pole devices for the protection and /or switching are in the phase conductor only
 - 5 All socket outlets and lamp holders are connected correctly
 - 6 All fire barriers and protection against thermal effects are in place
 - 7 All protective measures are in place to avoid direct contact to insulation or live parts such as:
 - 8 Barriers or enclosures are in place
 - 9 Obstacles are in place
 - 10 Equipment/fixtures out of reach
 - 11 All devices for isolation and switching are in place
 - 12 All settings of protective and monitoring devices have been chosen and set
 - 13 All labelling of circuits, fuses, switches and terminals are complete
 - 14 Check to ensure the equipment and protective measures are compatible with any external influences.
 - 15 The erection of the appropriate danger and other warning notices together with health and safety notices have been displayed in the correct locations
 - 16 All diagrams, instructions for operation that are required to be permanently fixed adjacent to the equipment shall be provided.
- C Ensure that sequence of testing is in accordance with the IEE Wiring Regulations and as listed below:
- 1 Continuity of ring final circuits and conductors
 - 2 Continuity of protective conductors, including main and supplementary equipotential bonding
 - 3 Earth electrode resistance
 - 4 Insulation resistance
 - 5 Insulation of site-built assemblies
 - 6 Protection by electrical separation
 - 7 Protection by barriers or enclosures provided during the installation
 - 8 Insulation of non-conducting floors and walls
 - 9 Polarity
 - 10 Earth fault loop impedance
 - 11 Operation of residual current devices and fault operated protective devices.
- D Record all on approved test sheets, witnessed and signed by:
- 1 The responsible person who carried out the test
 - 2 The witness to the test: Commissioning management Specialist
 - 3 Collate all test results for incorporation into the O&M Manuals.
- E Commissioning management specialist is required to Independently retest 10% of the static electrical tests on all power and lighting circuits. Should the tests indicate an unacceptable level of error the whole system is to be re-tested by the installing contractor.

Y50.3.6 FIRE DETECTION AND ALARM SYSTEMS TESTING

- A In addition, all tests to be witnessed by and to the satisfaction of the CA and local fire / building control authority and to the requirements of the installation codes of practice for such systems.

- B In addition to the general electrical test required by the IET Wiring Regulations carry out the following tests:
- 1 All alarm devices shall be operated to ensure that they comply with the audibility requirements specified elsewhere
 - 2 Ensure that all devices and alarm points function correctly
 - 3 Ensure that all monitoring and ancillary equipment functions correctly
 - 4 Ensure that facilities for remote monitoring function correctly
 - 5 Battery / charger condition to be verified.
- C Integrated testing should demonstrate that the following operate correctly when required to do so in a fire situation:
- 1 Stair pressurisation fans
 - 2 Smoke extract fans
 - 3 Smoke operated fire dampers
 - 4 Lifts
 - 5 Emergency call systems
 - 6 Any other Life Safety equipment.
 - 7 Automatic fire extinguishing equipment
- D Issue a certificate of satisfactory completion when all testing is complete. Demonstrate the complete operation of the systems to the satisfaction of the CA and building control authority.

Y50.3.7 EMERGENCY LIGHTING SYSTEMS TESTING

- A In addition to the tests required by the IET Wiring Regulations, provide the checks and tests in accordance with BS 5266.
- B Tests to be witnessed by the CMS and Building Control authority.
- C Provide the completion certificate as required by BS 5266 together with one copy of the emergency lighting logbook.

Y50.3.8 LIGHTING PERFORMANCE TESTING

- A Comply with the procedures and requirements of
- 1 Building Regulations L2
 - 2 CIBSE Commissioning Code L
 - 3 IES Design Guide DG-2—11 “The Commissioning Process Applied to Lighting Control Systems”
- B After completion of all electrical tests carry out the following checks prior to commissioning the control systems;
- 1 Check the design illuminance is achieved in all areas of the building. Refer to section B for design requirements.

Y50.3.9 TESTING OF SPECIALIST SYSTEMS

- A Specialist systems are to be fully tested and made ready for operation by the specialist contractors/manufacturers. This includes the following plant and systems.
- 1 Controls
 - 2 Fire Alarms
 - 3 Hot water generators
 - 4 Earthing Systems.
- B All testing to be witnessed by the CMS (Commissioning Management Specialist)
- C Collate all testing record information for incorporation into the Operation and Maintenance Manual by the Technical Documentation Specialist.

Y50.4 PART 4 – COMMISSIONING

Y50.4.1 PRECOMMISSIONING CHECKS

- A The Services Sub-contractors (Mechanical, Electrical and Plumbing) are required to pre-commission the systems to the requirements indicated below and in accordance with the "Commissioning Documents".
- B No system commissioning can commence until all the items have been checked and accepted by the CMS and the CA.
- C Each system, air, water, gas, chilled water or control system shall be deemed complete when the following checks have been passed by the CA and Commissioning Specialist Sub-Contractor.
- D **Air Systems:** Installation contractor to carry out the following checks and record when complete for each system/plant item:
- 1 All ductwork pressure tests complete
 - 2 All ductwork installed and labelled
 - 3 Inside of units free of debris
 - 4 Fan blades free to turn
 - 5 Motor secured
 - 6 Installed as manufacturer's requirements
 - 7 AV mounts in place and free to operate
 - 8 Doors/access panels secure and sealed
 - 9 All duct and grille dampers open
 - 10 Full load current checked
 - 11 Running currents checked
 - 12 Bearing temperature
 - 13 Bearings lubricated
 - 14 Checked belt and pulleys after running
 - 15 Fan rotation correct
 - 16 Ducts clean and free of debris
 - 17 Grilles fitted
 - 18 Test holes plugged
 - 19 Earth bonding complete
 - 20 Checked that all drains from cooling coils and humidifiers have water seals
 - 21 System confirmed safe to run.
- E **Water Systems:** Installation contractor to carry out the following checks and record when complete for each system/plant item:
- 1 Systems pressure tested and complete
 - 2 Pipework chemically clean
 - 3 Pipework flushed (see note below)
 - 4 System full
 - 5 All valves open
 - 6 Flexible connections satisfactory
 - 7 Rotation correct
 - 8 Earth bonding complete
- F **Control Systems:** Installation contractor to carry out the following checks and record when complete for each system/plant item:
- 1 Fire alarm interface available for operation
 - 2 Variable Speed Drives operate where specified
 - 3 All live components shrouded
 - 4 Control circuit logic tested
 - 5 All field wiring installed correctly
 - 6 All control devices correctly located

- 7 All devices checked for correct operation
- 8 Correct fuses installed.

G **Electrical Works:** Installation contractor to carry out the following checks and record when complete for each system/plant item:

- 1 Earthing to surrounding metal work completed
- 2 All insulation and short circuit tests with certificates completed
- 3 All distribution board charts completed
- 4 All terminations to be tightened and labelled
- 5 Confirmation that all equipment and testing is to current Edition of IET Wiring Regulations Manufacturer's test results.

Y50.4.2 DYNAMIC COMMISSIONING

- A Commission all services in accordance with CIBSE, HVCA, IET and BSRIA Technical Guidance and commissioning documents referred to in this specification.
- B Record all commissioning results on approved record sheets.

Y50.4.3 WATER SYSTEMS COMMISSIONING

- A Balance, regulate, and commission all water systems in accordance with the relevant "commissioning documents".
- B On completion of satisfactory pressure testing, each system shall be thoroughly flushed using clean water. The flushing operation shall continue until such time as all strainers and dirt pockets remain clear and clean water is discharged to the satisfaction of the CA.
- C The outflow from all cold and hot draw off points shall be demonstrated with full bore delivery from taps based in number on the diversity tables published in CIBSE Guide C. Demonstrate that a balance on any circulating system is being achieved.
- D All balancing valves to be marked in such a manner that they can be easily reset to the as balanced condition.
- E Collate all test results for incorporation into the O&M Manuals.

Y50.4.4 AIR SYSTEMS COMMISSIONING

- A Balance, regulate and commission all air systems in accordance with the relevant "commissioning documents".
- B Demonstrate air circulation and distribution of all systems.
- C Carry out running tests of all fans demonstrating volume and pressure generation, speeds and running current.
- D Measure and record pilot tube readings for all ductwork systems.
- E Calculate and record the as commissioned specific fan power for each ventilation system.
- F Collate all test results for incorporation into the O&M manuals.
- G Mark all balancing dampers to indicate the final balance point so that if sections are isolated they can easily be returned to the balanced condition.
- H Ensure that filter manometers are set up to indicate clean and dirty pressure drops.

Y50.4.5 FIRE ALARM SYSTEMS CAUSE AND EFFECT STRATEGY

- A Fire Alarm systems are to be commissioned by their specialist sub-contractor who is responsible for preparing the detailed Cause and Effect Strategy in a matrix format showing the interrelationship between the Fire Alarm activation inputs and the effect of the activation on various installations. Fire Alarm sub-contractor is to develop the case and effect matrix with assistance from:
- 1 Commissioning management Specialist
 - 2 Emergency Lighting sub-contractor
 - 3 Lighting control systems sub-contractor
 - 4 Trade contractors for each MEP system
 - 5 Building Control
- B Submit the detailed Cause and Effect matrix for approval and incorporate any requirements into the final submittal.

Y50.4.6 PLANT AND EQUIPMENT COMMISSIONING

- A Provide performance tests of all equipment by the relevant Sub-Contractor/manufacturer to demonstrate:
- 1 Correct installation in accordance with manufacturer's instructions
 - 2 Performance and duty
 - 3 Safety & protective devices and features.
- B Commissioning Specialist to witness all tests and collate all test results for incorporation into the O&M manuals.

Y50.4.7 LIGHTING SYSTEMS COMMISSIONING

- A Lighting Control systems: to be commissioned in line with manufacturers guidance.

Y50.4.8 INTEGRATED COMMISSIONING

- A The installed systems are not independent of each other and the effect of various different system inputs such as fire alarm, emergency condition, plant failure, security, on the operation of the plant is to be verified by the BMS sub-contractor. Any input that affects the operation of the plant is to be checked and the automatic or manual re-instatement to normal operational status is to be established.
- B All features of the plant operation are to be verified such as:
- 1 Life Safety shut down and restoration of normal operation
 - 2 Plant protection shut down and restoration of normal operation
 - 3 Fire alarm system interfaces
 - 4 Controlled conditions are achieved
 - 5 Plant operates to correct time schedules
 - 6 Plant starts in a suitable sequence
 - 7 Plant shuts down in an orderly manner
- C Record information on agreed documentation and submit to the CA for comment and review.
- D Collate all approved testing and commissioning records for inclusion in the O&M manuals.
- E Demonstrate, to the satisfaction of the CA, that the systems are properly regulated and set to work.
- F Ensure that all detectors, etc. are properly adjusted and calibrated and that all controlled conditions are achieved. Ensure that all systems operate to their design intent including all safety, alarm and control scenarios.

Y50.4.9 FINAL COMPLETION

- A Prepare the “draft” and “final” Operating and maintenance manuals prior to practical completion including review of the Record Drawings prepared by others.
- B Final completion of the commissioning will not be achieved until:
 - 1 All systems are satisfactorily commissioned
 - 2 Fire Alarm Cause and Effect is satisfactorily demonstrated
 - 3 Commissioning is satisfactorily demonstrated
 - 4 Integrated testing is complete and demonstrated
 - 5 Employer’s training is complete
 - 6 Approved final “Record Documents” are provided by the Technical Documentation Specialist with input from the Trade Contractors including:
 - a Building Logbook (if separate from Building Manual)
 - b Building Manual
 - c Building User Guide
 - d Operation and Maintenance Manuals for the Building services installations.
 - e Energy Performance Certificate
 - f Record drawings
 - g BIM Model
 - h Asset Register

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 V11 "Low Voltage Connection"
 - 2 V30 "Low Voltage Distribution System"
 - 3 V31 "Low Voltage Switchgear"
 - 4 V33 "Busbar Trunking"
 - 5 V40 "Small Power Systems"
 - 6 V80 "Electrical Identification"
 - 7 V81 "Earthing and Bonding Systems"
 - 8 Y50 Electrical Commissioning
 - 9 Y60 "Conduit and Trunking"
 - 10 Y63 "Cable Supports"
 - 11 Y67 "Transient over-voltage surge suppression devices"
 - 12 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 x86mm: 3, 4 modules
- 3 146mm x146mm: 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 flexible cord 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

Y90 FIXING TO BUILDING FABRIC

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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.

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)

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