



Steven A. Hunt & Associates

ROCHDALE TOUCHSTONES

MECHANICAL SERVICES SPECIFICATION



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SECTION ONE – TECHNICAL DESCRIPTION OF WORKS

1.1 SCOPE OF WORKS

1.1.1 General

This specification and associated tender drawings have been prepared by:

Steven A. Hunt & Associates
Hangar 9
De Havilland Drive
Speke
Liverpool
L24 8RN
Tel: 0151 427 8009
Contact for this scheme: Ethan Bayley

The Contractor shall read this specification in conjunction with all other tender documents.

1.1.2 Description of the Project

The project involves the refurbishment of a grade 2 listed building which involves the stripping out and remodelling of the ground floor and basement. There is consideration to refurbish the first floor art galleries at a later date. The purpose of the work is to reinvigorate a historically significant building, upgrading the interior design to make it both comfortable and community-centred all while maintaining its traditional look.

On the ground floor the design includes a civic dining room, a performance space, meeting rooms, messy and clean studios, co working spaces, a podcast studio and two classrooms along with various other spaces. The civic dining room will act as a multi-functional space, providing food and seating for visitors, it will often be used as a place for visitors to congregate before entering the neighbouring performance space which will host a variety of different entertainment acts.

The basement consists of a large co working space occupied by Your Trust, meeting rooms, zoom pods, storage areas, staff breakout spaces, the main plantroom, a workshop space, and a storage area for artwork that is not on display in the gallery. This area is less open to the public and more exclusive to Touchstones staff and Your Trust employees.

The existing plantroom equipment is going to be retained but is due to be replaced by a district heating circuit in the future, this is the reasoning behind all the LPHW supplies being sized of a flow/return rate of 55°C/45°C. The existing boiler room is to remain in place and shall serve the new distribution system.

The mechanical contractor is responsible for the supply of all labour, supervision, transportation, materials and supply of plant and equipment necessary to install and test a complete and functioning installation as outlined below.

- Strip out works
- New air handling plant
- Air conditioning installations
- Supply and extract ventilation systems
- MEV to WC's and kitchens
- Heating installations
- Domestic Hot and cold water services
- Above ground drainage installations

- BMS installation and controls
- Commissioning and testing

When the contractor takes possession of the site the existing services to all areas within the scope of the site and adjacent areas shall remain live and strip out and disconnections form part of this scheme as detailed later in this specification.

The contractor is to fully familiarise themselves with the existing installations, the extent of which is detailed on the tender drawings. Any discrepancies between these and what is surveyed on site shall be brought to the consultant's attention prior to strip out on site.

The sub-contractor is to prepare a tender for supplying, installing and commissioning the services as detailed within this Specification and as per the accompanying drawings the Architect's drawings and the Structural Engineers drawings.

This specification MUST be read in conjunction with all other tender information and drawings issued under this contract. If any anomalies exist, the Contractor must clarify these during the tender period. No claims will be considered after the tender period due to lack of information.

The Contractor shall carry out the supply and installation of all services described herein in accordance with the general, technical, and specific material requirements, and as required by the following:

- Statutory Authority Requirements
- Local Authority Regulations
- Building Regulations including Fire Officers Requirements
- The Health & Safety Regulations (1974)
- Electricity, Water Authority Regulations or Byelaws
- Latest IEE Regulations for Electrical Installations (18th edition)
- Relevant British Standards
- CDM Regulations
- CIBSE Design Manuals, Technical Memoranda and Recommendations
- ILE Guidance Note on reduction of unobtrusive light
- Requirements of Legionella Prevention in Buildings
- Water Regulations

Any clarification required in relation to the meaning or importance of the Tender Documents shall be dealt with during the tender period and a full financial allowance shall be incorporated into the tender submission.

The tender must include documents without exclusions in any respect. The substance and conclusion relating to any clarification of the tender shall be circulated to all Tenderers.

Upon completion the entire installation is to be tested and left in full working order allowing the client immediate use of all facilities following practical completion.

1.1.3 Definitions

The term 'Works' shall mean the whole of the engineering services, and associated builder's work, described in this Specification and detailed on the drawings enumerated hereinafter.

The term 'Employer' or 'Client' shall mean;

Rochdale Development Agency
Number One Riverside
Smith Street
Rochdale
OL16 1XU
Contact - Oliver Boaler

The term 'Architect' shall mean;

Architectural Emporium
87 Kempton Street
Liverpool
L3 8HE
Contact – Luke Cooper (07968166174)

The term 'Main Contractor' shall mean;

TBC

The term 'Quantity Surveyor' shall mean;

Identity Consult
3 Caxton Road
Preston PR2 9ZZ
W: www.identityconsult.co.uk
T: @identityconsult.co.uk
Contact – Chris Allsop

The term Project Manager shall mean;

Hive Projects
1 St Peter's Square
Manchester
M2 3DE
Contact – James Quirk

The term 'Structural Engineer' shall mean;

Sutcliffe
18-20 Harrington Street
Liverpool
L2 9qa
Contact – Kate Watson (07968 514668)

The term 'Services Engineer' shall mean;

Steven A. Hunt & Associates Ltd.
Hangar 9
De Havilland Drive
Speke
Liverpool
L24 8RN
Tel: 0151 427 8009

The term 'Main Contractor' shall mean the contractor engaged to carry on the complete works for the project.

The term 'Mechanical Contractor' shall mean the Sub Contractor engaged to carry out the Works described in this Mechanical Specification.

The term 'Electrical Contractor' shall mean the Sub-Contractor engaged to carry out the electrical Section of Works described in the electrical Specification.

The term 'Designer' shall mean the design engineer engaged by the Employer to carry out the Section of Works described in this Specification.

The term 'Specialist Sub-Contractor' shall mean the Contractor engaged by the Sub Contractor to carry out certain works under Domestic Sub-Contract Agreements, having first gained the approval of the Employer, which will not be unreasonably withheld.

The Main Contractor shall ensure that all Contractors comply with all parts detailed in this Specification.

1.1.4 Drawings

The drawings accompanying this Specification are full design drawings the contractor shall prepare their own working, fabrication and builders work drawings based on the design drawings.

Refer to the Mechanical Drawing Issue Sheet for the drawings to accompany this specification.

1.1.5 Site Visits

A site visit may be made to the existing building. Arrangements are to be made through Melissa Buttigieg melissa.buttigieg@yourtrustrochdale.co.uk. Forty-eight hours' notice must be given to allow the necessary arrangements to be made

The sub-contractor is recommended to visit the site as no claim will be accepted by the Consulting Engineer with respect to the lack of knowledge of the building.

Without this visit the mechanical sub-contractor will not be able to provide a tender bid that provides a true reflection of the works required and as such any additional claims for costs after the tender submission shall not be accepted

1.1.6 Submissions with Tender

The sub-contractor shall submit with the tender the following information:

- a) The completed tender breakdown. It should be noted that there is strict control on the funding of this project, and it is extremely important that the cost breakdowns indicated in the tender are adhered to.
- b) A covering letter with any discrepancies and exclusions.
- c) Notification of any variations to the Specification and explanations for a change requirement
- d) Notification of any extended delivery periods, i.e. any items of equipment over six weeks.
- e) All sub-contractors proposed for the project shall be declared within the tender package.
- f) Project risk assessments.
- g) Material procurement schedules.

1.1.7 Specialist Quotations

Within this Specification reference may be made to specialist suppliers and sub-contractors' quotation references. It is the mechanical sub-contractor's responsibility to ensure these quotations include for all works, quantities and details as specified herein and shown upon the contract drawing. The Design team shall not be responsible for the verification of such quotes. The tender drawings and specification represent the final design intent

The Main Contractor will accept no claim by the sub-contractor for any misinterpreted details or quantities derived from a quotation.

1.1.9 Removal of Existing

Certain services and plant will be retained and therefore careful consideration should be enforced to make sure of this. The main heating plant including the domestic hot water heater will all be retained and the 1st floor service arrangements will be retained and provisions will be made to connect into the new system, as illustrated on drawings. The retained 1st floor shall be connected back to the new system

The contractor shall include to isolate, disconnect and remove all services rendered redundant by the new installations and for the removal of the same from site generally as detailed on the tender drawings.

The contractor shall also include to take existing photographs of the existing plantroom prior to any works taking place as a reference point.

The mechanical contractor shall include for the removal of existing services to accommodate the new installation.

In order to assess the requirements of this section of works the contractor is to visit site and familiarise himself with the existing services. No claim will be accepted by the Consulting Engineer with respect to lack of knowledge of the building structure and the extent of the existing services.

Existing cast iron radiators to be stripped out but retained and passed to the client for storage.

The mechanical sub-contractor shall include for all necessary costs associated with the safe and correct removal and disposal of all redundant equipment off site.

1.2 MECHANICAL VENTILATION

1.2.1 General

There will be a combination of mechanical and natural ventilation implemented at ground and basement level, in order to maintain the existing external façade natural ventilation is to be used in rooms wherever possible via openable windows. In certain spaces openable windows are not possible, in these cases mechanical ventilation has been proposed.

External louvres are to be implemented within existing windows spaces where necessary, positions agreed with Architectural Emporium and shown clearly on design.

The provision, installation, testing and commissioning of the mechanical supply and extract systems shall comply with the requirements of the CIBSE Guides and British standards.

Proprietary materials shall be installed in accordance with the manufacturer's recommendation and when required the contractor shall ensure his operatives receive the technical instruction or short courses on correct installation techniques.

The new systems include the following works:

- MVHR system serving Zoom Pods, meeting room and working space
- MEV system serving basement WCs
- New fresh air supply and extract AHU serving performance space, civic dining room, commercial kitchen
- MEV system serving Ground floor WCs
- MVHR system serving Clean Studio
- MEV System serving Staff Kitchen and WCs
- MVHR system serving kiln, IT room, Meeting room, podcast studio and quiet room
- MVHR system serving both classrooms, and WCs

1.2.2 Main Air Handling Unit

The contractor shall include for the supply and installation of a new air handling unit mounted on the mezzanine located above the ground floor WCs, the unit will be separated into separate supply and extract units due to the height of the void. This unit will serve the commercial kitchen, civic dining room, performance space.

The air handling unit shall be as manufactured and supplied by:

Complete Ventilation Solutions Ltd,
Unit 4
Tapton Way
Liverpool,
Merseyside,
L13 1DA
Tel: 07557 733347
Email mark.hadfield@completeventsolutions.co.uk

The contractor shall supply and install an Exhausto VEX5050 modular air handling unit with supply and extract air and heat recovery via run around coil. The unit is supplied as a separate supply and extract AHU.

The unit is to be capable of delivering the following air flow rates

Supply air output: 2.55 m³/s at 475 Pa
Exhaust air output: 2.55 m³/s at 475 Pa

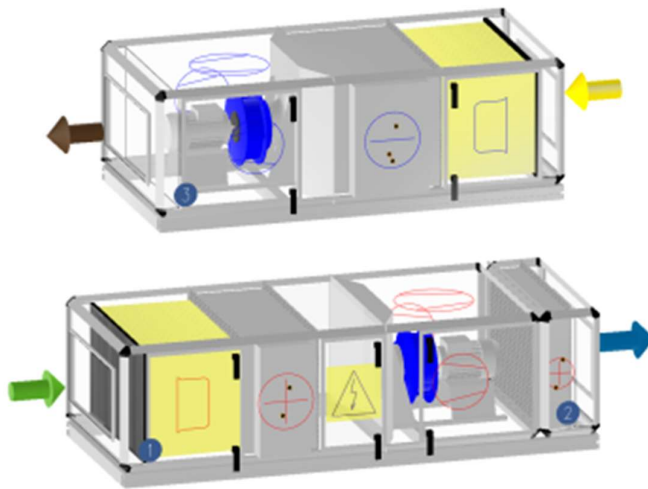
The Supply unit overall size is as follows:

Width: 1417 mm
Height: 1017 mm
Length: 3517 mm
Weight: 636 kg

The Extract unit overall size is as follows:

Width: 1417 mm
Height: 1017 mm
Length: 2997 mm
Weight: 523 kg

Connection sizes: approximately 600 x 600 mm



The Supply unit is to comprise of the following:

- Fresh air supply with VCD and Belimo actuator.
- Filter section with F7 filters monitored via a differential pressure switch
- Manometer pressure gauge
- Air temperature sensors
- Run around pre-heater coil -5°C EAT
- Supply air plug fan – inverter driven
- Main heater battery heating air to 21°C via LPHW 55°C/45°C

The extract unit is to comprise

- Return air filter section with F7 filter monitored via a differential pressure switch
- Run around coil
- Extract air plug fan – inverter driven
- Exhaust air with VCD and Belimo actuator.
- Manometer pressure gauge

The sound data for the unit is as follows:

Supply & Extract Fan

Sound power level

Octave band	63	125	250	500	1k	2k	4k	8k		Total
To outdoor duct	67	58	72	60	61	61	50	45	dB	68 dB(A)
To supply duct	84	67	88	80	82	81	77	76	dB	87 dB(A)
To extract duct	66	58	72	59	61	60	50	45	dB	67 dB(A)
To exhaust duct	83	67	87	80	82	80	77	75	dB	87 dB(A)
To surroundings	66	66	76	62	61	54	47	46	dB	69 dB(A)

The modular housings are to be constructed with frame sections and insulated panels. The closed frame parts are to be made from aluminium connected with inserted angles and rounded edges.

The wall panels of the unit shall consist of Aluzinc sheeting (AZ185) in corrosion protection class C4 and insulated with 50 mm mineral wool. The insulation shall conform to DIN 4102

Construction Material Class A1 and shall be inflammable. The walls shall be double construction, airtight and flush-fitting. The side walls shall be screwed to the frame parts, allowing them to be removed for major maintenance work. The end, top and base panels shall be fixed internally with screws.

The unit shall be supplied with a base frame.

Seals between the module connections and between all connections and the necessary air-side elastic connection spigots shall be fitted with ageing-resistant, elastic, self-adhesive gaskets.

Doors to have robust, easily operated, lockable handles. The doors shall be able to be opened 180° for inspection and maintenance purposes. The doors shall be constructed under the same principle as the panels, except with rubber seals. Adjustable hinges shall be located on the door frames.

Multi-blade louvre dampers and frames shall be made from steel sheet frame sections with slats made from aluminium with plastic bearings. Multi-blade louvre dampers shall have corrosion-resistant drive cams connected directly to the slat motors with a connecting rod and tested to EN1751 Leakage Class

Filter shall be provided in accordance with ISO 16890. Rubber seals are to be fixed to the frame of the ventilation unit housing. The filter frame shall be pressed firmly against the sealing strips. Filter monitoring shall be provided for the supply and extract air filters and shall be fitted with a manometer for visual control of filter contamination.

The unit is to be mounted on the mezzanine roof and shall be supplied in sections for ease of installation.

1.2.3 Grilles & Diffusers

The sub-contractor shall supply and install Grilles and Diffusers as manufactured by:

Gilberts (Blackpool) Ltd

Head Office and Works
Clifton Road
Blackpool
Lancashire FY4 4QT
Tel: 01253 766911
Fax: 01253 767941

Mobile: 07464547554
Direct Fax: 01253 608201
Email: jasonlaugharne@gilbertsblackpool.com

Grilles and diffusers shall all have a polyester powder paint finish in white RAL 9010.

All grilles and plenum boxes shall be independently supported from the soffit.

The grilles shall be as detailed on the schedules detailed below and on the tender drawings.

SG5 to SG12 drum louvres in the performance space are to have 24V motorised damper blades to adjust the blade angle between winter and summer operation. All drum louvres are to be wired in parallel and linked to the BMS as described later.

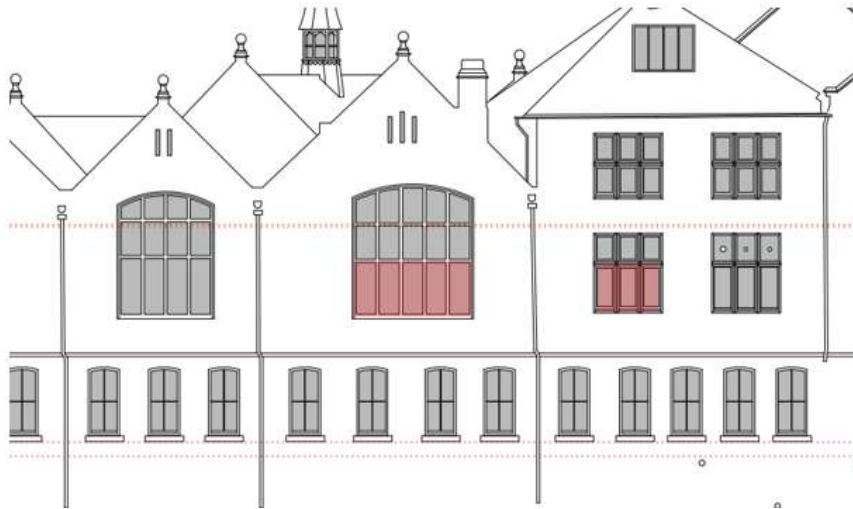
Gilberts Grille Schedule - Supply (Basement)							
Ref	Room Name	Function	Grille Type	Plenum	Air Vol	Dimensions	
					(m3/s)	Face Size	Spigot
SG1	Zoom Pod R1.03	Supply	SX100	Top	0.010	134dia	100dia
SG2	Zoom Pod R1.04	Supply	SX100	Top	0.010	134dia	100dia
SG3	Meeting Room R1.05	Supply	SX200	Top	0.225	599x599	400x400
SG4	Quiet Working Space R1.06	Supply	SX125	Top	0.225	599x599	400x400
Gilberts Grille Schedule - Supply (Ground Floor)							
Ref	Room Name	Function	Grille Type	Plenum	Air Vol	Dimensions	
					(m3/s)	Face Size	Spigot
SG5	Performance Space (motorised)	Supply	DL3/DO	Top	0.181	525x208	475x157
SG6	Performance Space (motorised)	Supply	DL3/DO	Top	0.181	525x208	475x157
SG7	Performance Space (motorised)	Supply	DL3/DO	Top	0.181	525x208	475x157
SG8	Performance Space (motorised)	Supply	DL3/DO	Top	0.181	525x208	475x157
SG9	Performance Space (motorised)	Supply	DL3/DO	Top	0.181	525x208	475x157
SG10	Performance Space (motorised)	Supply	DL3/DO	Top	0.181	525x208	475x157
SG11	Performance Space (motorised)	Supply	DL3/DO	Top	0.181	525x208	475x157
SG12	Performance Space (motorised)	Supply	DL3/DO	Top	0.181	525x208	475x157
SG13	Civic Dining Room	Supply	DL1/DO	Top	0.138	297x208	246x157
SG14	Civic Dining Room	Supply	DL1/DO	Top	0.138	297x208	246x157
SG15	Civic Dining Room	Supply	DL1/DO	Top	0.138	297x208	246x157
SG16	Civic Dining Room	Supply	DL1/DO	Top	0.138	297x208	246x157
SG17	Multi-faith Space R0.26	Supply	SXD125	Top	0.020	148dia	124dia
SG18	Clean Studio R0.29	Supply	GSFR250	Top	0.055	330dia	252dia
SG19	Clean Studio R0.29	Supply	GSFR250	Top	0.055	330dia	252dia
SG20	Clean Studio R0.29	Supply	GSFR250	Top	0.055	330dia	252dia
SG21	Clean Studio R0.29	Supply	GSFR250	Top	0.055	330dia	252dia
SG22	Kiln R0.53	Supply	SXD150	Top	0.030	175dia	149dia
SG23	Digital Co Working Studio R0.32	Supply	GSFR250	Top	0.060	330dia	252dia
SG24	IT / Digital Studio R0.39	Supply	GSFR160	Top	0.030	240dia	162dia
SG25	Podcast Studio R0.40	Supply	SXD150	Top	0.030	175dia	149dia
SG26	Quiet Room R0.47	Supply	SXD125	Top	0.020	148dia	124dia
SG27	Corridor R0.41	Supply	GSFR160	Top	0.060	369x369	225x225
SG28	Classroom 1 R0.48	Supply	GSFR250	Top	0.075	330dia	248dia
SG29	Classroom 1 R0.48	Supply	GSFR250	Top	0.075	330dia	248dia
SG30	Classroom 1 R0.48	Supply	GSFR250	Top	0.075	330dia	248dia
SG31	Classroom 1 R0.48	Supply	GSFR250	Top	0.075	330dia	248dia
SG32	Classroom 2 R0.50	Supply	GSFR250	Top	0.075	330dia	248dia
SG33	Classroom 2 R0.50	Supply	GSFR250	Top	0.075	330dia	248dia
SG34	Classroom 2 R0.50	Supply	GSFR250	Top	0.075	330dia	248dia
SG35	Classroom 2 R0.50	Supply	GSFR250	Top	0.075	330dia	248dia

Gilberts Grille Schedule - Extract (Basement)							
Ref	Room Name	Function	Grille Type	Plenum	Air Vol	Dimensions	
					(m3/s)	Face Size	Spigot
EG1	Zoom Pod R1.03	Extract	GXD100	Side	0.010	134dia	100dia
EG2	Zoom Pod R1.04	Extract	GXD100	Side	0.010	134dia	100dia
EG3	Meeting Room R1.05	Extract	GXD200	Side	0.080	241dia	200dia
EG4	Quiet Working Space R1.06	Extract	GXD125	Side	0.020	148dia	125dia
EG5	WC R-1.17	Extract	GX100	Top	0.008	134dia	100dia
EG6	WC R-1.21	Extract	GX125	Top	0.023	148dia	125dia
EG7	WC R-1.20	Extract	GX100	Top	0.008	134dia	100dia
EG8	WC R-1.18	Extract	GX100	Top	0.008	134dia	100dia
EG9	WC R-1.16	Extract	GX100	Top	0.008	134dia	100dia
Gilberts Grille Schedule - Extract (Ground Floor)							
Ref	Room Name	Function	Grille Type	Plenum	Air Vol	Dimensions	
					(m3/s)	Face Size	Spigot
EG10	WC R0.13	Extract	GX100	Top	0.010	134dia	100dia
EG11	WC R0.14	Extract	GX100	Top	0.010	134dia	100dia
EG12	WC R0.15	Extract	GX100	Side	0.010	134dia	100dia
EG13	WC R0.16	Extract	GX100	Side	0.010	134dia	100dia
EG14	WC R0.17	Extract	GX100	Side	0.010	134dia	100dia
EG15	WC R0.18	Extract	GX125	Side	0.020	148dia	125dia
EG16	WC R0.20	Extract	GX125	Side	0.030	148dia	125dia
EG17	Multi-faith Space R0.26	Extract	GX125	Top	0.020	148dia	125dia
EG18	Clean Studio R0.29	Extract	450x450	Side	0.220	495x495	450x450
EG19	Kiln R0.53	Extract	GX150	Top	0.030	191dia	150dia
EG20	WC R0.33	Extract	GX100	Top	0.010	134dia	100dia
EG21	WC R0.34	Extract	GX100	Top	0.010	134dia	100dia
EG22	A.WC R0.35	Extract	GX125	Top	0.020	148dia	125dia
EG23	Kitchen R0.37	Extract	GX125	Wall	0.020	148dia	125dia
EG24	Digital Co Working Studio R0.32	Extract	G250	Top	0.060	295x295	250x250
EG25	IT / Digital Studio R0.39	Extract	GXD150	Top	0.030	191dia	150dia
EG26	Podcast Studio R0.40	Extract	GXD150	Top	0.030	191dia	150dia
EG27	Quiet Room R0.47	Extract	GXD125	Top	0.020	148dia	125dia
EG28	WC R0.43	Extract	GX100	Top	0.010	134dia	100dia
EG29	WC R0.44	Extract	GX100	Top	0.010	134dia	100dia
EG30	WC R0.45	Extract	GX100	Top	0.010	134dia	100dia
EG31	WC R0.46	Extract	GX125	Top	0.020	148dia	125dia
EG32	Classroom 1 R0.48	Extract	Series G	Side	0.300	545x595	500x550
EG33	Classroom 2 R0.50	Extract	Series G	Side	0.300	545x595	500x550

The sub-contractor is to check the quantity of grilles against those indicated on the drawings and shall make the consultant aware of any discrepancies.

1.2.4 External Louvres

External louvre are to be accommodated within the existing window fenestration along the rear elevation replacing existing glass panes with louvres which need to be sized to fit within each of the individual window frames.shown in red below such that the frames remain in tact.



Contractor to install Gilberts WGF38/BG louvres, to a colour to be confirmed by Architect prior to ordering. Balance of louvres not used for air transfer to be blanked, approximate louvre sizes have been listed in schedule below and shown on drawings.

4025 Touchstones - Louvre Schedule						
REF	Manufacturer	Louvre Type	Intake/Exhaust	Width (mm)	Height (mm)	Area (mm ²)
L01	GILBERTS	WGF-38	Exhaust	500	500	250
L02	GILBERTS	WGF-38	Supply	500	500	250
L03	GILBERTS	WGF-38	Exhaust	300	300	90
L04	GILBERTS	WGF-38 Fire Dampered	Exhaust	550	550	302.5
L05	GILBERTS	WGF-38	Exhaust	300	300	90
L06	GILBERTS	WGF-38	Exhaust	700	1800	1260
L07	GILBERTS	WGF-38	Exhaust	700	1800	1260
L08	GILBERTS	WGF-38	Exhaust	700	1800	1260
L09	GILBERTS	WGF-38	Exhaust	700	1800	1260
L10	GILBERTS	WGF-38	Supply	700	1800	1260
L11	GILBERTS	WGF-38	Supply	700	1300	910
L12	GILBERTS	WGF-38	Supply	700	1300	910
L13	GILBERTS	WGF-38	Supply	700	1300	910
L14	GILBERTS	WGF-38	Supply	700	700	490
L15	GILBERTS	WGF-38	Exhaust	300	300	90
L16	GILBERTS	WGF-38	Exhaust	1000	1000	1000
L17	GILBERTS	WGF-38	Supply	1000	1000	1000
L18	GILBERTS	WGF-38	Extract	700	700	490

The above sizes are approximate and final Louvre measurements within each window frame where applicable are to be measured on site.

1.2.5 Attenuators

Provide and install a range of attenuators as manufactured by:-

Allaway Acoustics
Old Police Station,
1 Queens Road,
Hertford,
SG14 1EN
Contact: Will Twigg
Email: will.twigg@allawayacoustics.co.uk
Mobile: 07927 806669

The contractor shall be responsible for liaison with between the air handling unit suppliers and the attenuator manufacturer to ensure that suitable noise levels to suit NR35 Internally and 45dB(A) at 5m externally are achieved.

Attenuators shall be supplied and installed on intake and job side of all fans as shown on the drawings. Cross talk attenuators shall also be fitted to the basement meeting rooms system as shown on the drawings and to the ground floor Studios as shown on the drawings.

The contractor prior to installation shall send finalised drawings and equipment noise levels to the attenuator supplier to check the selections prior to manufacture. The attenuators shall all be site checked dimensionally prior to orders being placed as physical constraints may dictate that the cross-sectional shape of the silencers may need to be adjusted to suit

The attenuator supplier shall then undertake acoustic calculations to ensure that the attenuators achieve the specified noise criteria, based upon the finalised information.

A Technical Submittal comprising acoustic calculations and a finalised schedule of attenuators shall then be issued to the Consultant for final approval.

If an alternative attenuator supplier is proposed then the Contractor shall allow for them to undertake witnessed tests to prove their claimed insertion loss performance in a UKAS accredited BS EN ISO 7235: 2009 test facility, for two sample units. This shall be undertaken prior to order.

Pressure losses are stated in accordance with ISO 7235, which is based on laminar airflow conditions. The system designer shall make allowance for increased attenuator pressure losses where turbulent airflow conditions exist on the attenuator entry or exit.

Unless stated otherwise all attenuators shall be constructed as follows: Galvanised sheet steel casings with 30mm profile flanges that are fully compliant with DW/TM1 at a high pressure rating (+2000/-750Pa).

Profile flanges shall be compatible with Doby, Mez & Metu flanging systems.

Elements shall be installed in the vertical plane, with side elements provided as standard, and all elements shall have aerodynamic inlet and outlet fairings.

Element facings shall be constructed from expanded galvanised steel mesh with fibre glass tissue bonded to the inner face. Mineral wool infill shall be overpacked to minimise voids due to settlement. Attenuator ends shall be protectively wrapped, and all attenuators shall be delivered to site on pallets and individually labelled.

1.2.6 Air Volume Control Regulators

Variable air volume control boxes are to be provided on the supply and extract ductwork to the Commercial Kitchen, Civic Dining Room and Performance Space each have variable air volume (VAV) units as supplied by Trox.

The units are to enable the mechanical ventilation system to regulate air flow according to demand between the three spaces.

The units are to be supplied with attenuators and 24v Belimo actuators for control as described elsewhere in this specification.

Performance Space:

VAV1 - Supply: WLMD/600/400 + 5L-SP Attenuator. Vmax=1450l/s. Vmin=500l/s. Pressure drop <25Pa.

VAV2 - Extract: WLMD/600/400 + 5L-SP Attenuator. Vmax=1450l/s. Vmin=500l/s. Pressure drop <25Pa.

Dining Room:

VAV3 - Supply: WVSU-S/315. Vmax=500l/s. Vmin=500l/s. Pressure drop <25Pa.

VAV4 - Extract: WVSU-E/250. Vmax=300l/s. Vmin=300l/s. Pressure drop <25Pa.

Kitchen:

VAV5 - Supply: WVSU-S/315. Vmax=550l/s. Vmin=200l/s. Pressure drop <25Pa.

VAV6 - Extract: WVSU-E/400. Vmax=930l/s. Vmin=250l/s. Pressure drop <30Pa

VAV boxes to be supplied by:

Waterloo Air Products Ltd
Swegon (Unit A)
ME6 5SL
Kent
Tony Sherlock CEng BEng (Hons) MCIBSE
Email: tony.sherlock@swegon.com
Tel +44 (0)1634 981500
Mobile +44 7391 011605

1.2.7 Mechanical Heat Recovery units

The heat recovery units are to be as follows:

Basement

Zoom Pods

Mitsubishi LGH-65RVX3-E

System should include:

- Flexible connections
- Anti-vibration mounts

The unit is to supply and extract air from both the zoom pods, the meeting room and the quiet working space. Control shall be via time channel operating fan at low speed with local boost controller activating high speed for one hour.

Required air volume = 120l/s

Unit dimensions:

908mm width

954mm depth

404mm height

Plantroom

Caladair Silvertop08

System should include:

- Flexible connections
- Anti-vibration mounts
-

This unit is to be located in R-1.22 plantroom and will stand on crimped feet integrated to the frame for handling and ground fixing, the unit will serve the kiln in messy studio, IT/Digital studio, digital co working studio, podcast studio and quiet room. Control shall be via timechannel

Required air volume: 170l/s

Dimensions:

1265mm width

700mm depth

1150mm height

Ground floor

Breakout Space/Store

Mitsubishi Lossnay LGH-160RVX3-E

System should include:

- Flexible connections
- Anti-vibration mounts

Unit is to be suspended on the break out space ceiling but will serve both the clean studio and the multi-faith space with supply and extract. Control shall be via timechannel

Required air volume = 330l/s

Unit dimensions:

1144mm width

1004mm depth

808mm height

Classrooms & toilets

The contractor shall include for the supply and installation of a MVHR unit mounted on the mezzanine board located above the ground floor classroom WCs, the unit will have supply and extract units stacked upon one another. This unit will serve the two classrooms, WC's and hallway, maintenance hatch location shown on drawing.

The air handling unit shall be as manufactured and supplied by:

Complete Ventilation Solutions Ltd,

Unit 4

Tapton Way

Liverpool,

Merseyside,

L13 1DA

Tel: 07557 733347

Email mark.hadfield@completeeventsolutions.co.uk

The contractor shall supply and install an Exhausto VEX4020 modular air handling unit with supply and extract air and heat recovery via plate heat exchanger.

The unit is to be capable of delivering the following air flow rates

Supply air output: 0.713 m³/s at 250 Pa

Exhaust air output: 0.713 m³/s at 250 Pa

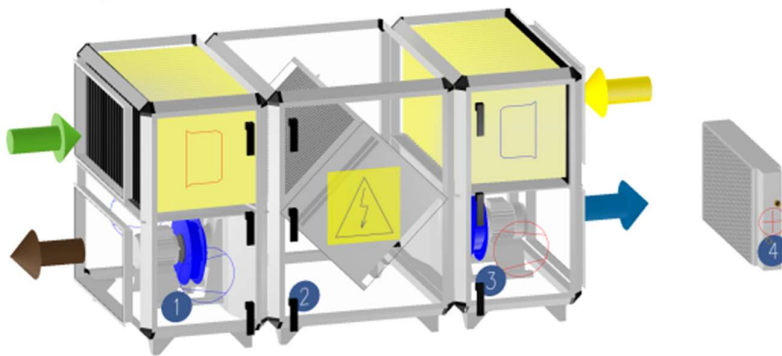
The unit overall size is as follows:

Width: 1275 mm

Height: 1409 mm

Length: 2462 mm

Weight: 650 kg



The Supply unit is to comprise of the following:

- Fresh air supply with VCD and Belimo actuator.
- Filter section with F7 filters monitored via a differential pressure switch
- Manometer pressure gauge
- Air temperature sensors
- Plate heat exchanger
- Supply air plug fan – inverter driven
- Main heater battery heating air to 21°C via LPHW 55°C/45°C

The extract unit is to comprise

- Return air filter section with M5 filter monitored via a differential pressure switch
- Plate heat exchanger
- Extract air plug fan – inverter driven
- Exhaust air with VCD and Belimo actuator.
- Manometer pressure gauge

The sound data for the unit is as follows:

Supply & Extract Fan

Sound power level

Octave band	63	125	250	500	1k	2k	4k	8k		Total
To outdoor duct	47	63	62	56	43	41	34	22	dB	57 dB(A)
To supply duct	52	61	71	68	69	65	62	55	dB	73 dB(A)
To extract duct	46	62	61	56	42	40	34	21	dB	56 dB(A)
To exhaust duct	52	60	71	69	70	67	63	58	dB	74 dB(A)
To surroundings	60	62	57	46	46	40	35	29	dB	52 dB(A)

The modular housings are to be constructed with frame sections and insulated panels. The closed frame parts are to be made from aluminium connected with inserted angles and rounded edges.

The wall panels of the unit shall consist of Aluzinc sheeting (AZ185) in corrosion protection class C4 and insulated with 50 mm mineral wool. The insulation shall conform to DIN 4102 Construction Material Class A1 and shall be inflammable. The walls shall be double construction, airtight and flush-fitting. The side walls shall be screwed to the frame parts, allowing them to be removed for major maintenance work. The end, top and base panels shall be fixed internally with screws.

The unit shall be supplied with a base frame.

Seals between the module connections and between all connections and the necessary air-side elastic connection spigots shall be fitted with ageing-resistant, elastic, self-adhesive gaskets.

Doors to have robust, easily operated, lockable handles. The doors shall be able to be opened 180° for inspection and maintenance purposes. The doors shall be constructed under the same principle as the panels, except with rubber seals. Adjustable hinges shall be located on the door frames.

Multi-blade louvre dampers and frames shall be made from steel sheet frame sections with slats made from aluminium with plastic bearings. Multi-blade louvre dampers shall have corrosion-resistant drive cams connected directly to the slat motors with a connecting rod and tested to EN1751 Leakage Class

Filter shall be provided in accordance with ISO 16890. Rubber seals are to be fixed to the frame of the ventilation unit housing. The filter frame shall be pressed firmly against the sealing strips. Filter monitoring shall be provided for the supply and extract air filters and shall be fitted with a manometer for visual control of filter contamination.

The unit is to be mounted on the mezzanine roof and shall be supplied in sections for ease of installation.

The unit is to be supplied with a supplementary LPHW heater battery to elevate the incoming air to 21oC via LPHW at 55/45oC.

1.2.8 Mechanical Extract units

Mechanical extract ventilation units will be installed in the following spaces:

Basement

Toilet Extract – Vent-Axia Sentinel D-Box Twin Fan SENT125T

The Sentinel unit is internally treated with an 'O' class rated, BS476 part 6 & 7 acoustic foam. The unit comes with a specially designed mounting bracket to make installation easier.

Required flowrate

Total Dimensions:

Length: 443mm

Width: 192mm

Height: 400mm

Kitchen Extract – Vent-Axia TX7 wall fan

Unit comes with telescopic liners for fitting in wall, controller to be supplied which gives control over choice of speeds, reversible airflow direction and automatics sensor operation.

Dimensions:

Width: 352mm

Height: 345mm

Ground floor

Toilet Mini Kitchen Extract – Vent-Axia Sentinel D-Box Twin Fan SENT150T

The Sentinel unit is internally treated with an 'O' class rated, BS476 part 6 & 7 acoustic foam. The unit comes with a specially designed mounting bracket to make installation easier.

Required flowrate

Total Dimensions:

Length: 443mm

Width: 192mm

Height: 400mm

Toilet Extract – Vent-Axia Sentinel D-Box Twin Fan SENT150T

The Sentinel unit is internally treated with an 'O' class rated, BS476 part 6 & 7 acoustic foam. The unit comes with a specially designed mounting bracket to make installation easier.

Required flowrate

Total Dimensions:

Length: 443mm

Width: 192mm

Height: 400mm

All of the mechanical extract units will extract air from the selected spaces and extract to outdoors via exhaust louvres that have been clearly illustrated on the drawings.

1.2.9 Ductwork

The mechanical sub-contractor shall employ a specialist ductwork sub-contractor to install ductwork in accordance with DW144 and DW172 in kitchen.

Kitchen extract shall be via a commercial canopy supplied and fitted by others, the mechanical sub-contractor is to install DW172 supply and extract ductwork to canopy.

Supply ductwork in the Performance space shall rise to high level and shall have side mounted drum louvres with motorised blades to switch between winter and summer. All exposed ductwork shall have its lagging finished with Ventureclad in a colour to be confirmed by Architect.

Extract ductwork in the Performance space shall rise to high level and shall pass into the existing roof void where it shall terminate with a bell mouth and shall draw exhaust air from the existing ceiling grilles.

Ductwork shall be installed to BESA TR/19 requirements (Internal cleanliness High quality, advanced level of cleanliness) and access doors shall be incorporated into the system to facilitate cleaning as noted also in this document

Ductwork shall be pressure tested to DW143 irrespective of the system size and operating duty. All systems shall be tested.

Supply ductwork in performance space to be exposed and to distribute supply air via drum louvres, air to be extracted from the existing ceiling grilles in roof void, as illustrated on issued drawing.

The ductwork insulation finish shall be installed in the colour 'Heritage White' RAL TBC, mechanical sub-contractor is to supply a sample prior to works.

Fire dampers shall be installed in accordance with BSRIA standard "building in" details and to the requirements in DW 145.

The ductwork sub-contractor is to supply and install all galvanised sheet metal circular and rectangular ductwork as shown on the drawings.

The sub-contractor shall include for taking site dimensions and preparing ductwork fabrication drawings. Copies of the fabrication drawings shall be submitted to the Consulting Engineer for approval prior to any work commencing on site.

The sub-contractor shall be entirely responsible for any specialist contractor employed by him for the manufacture and erection of the ductwork installation. The specialist contractor shall be subject to the approval of the Consulting Engineer.

The manufacture and erection of all ductwork shall be to a high standard of construction and quality. Any unsatisfactory or poor work shall not be accepted and shall be replaced at no extra cost to the project and without delay to the contract programme.

Circular ductwork shall be spirally wound and all branches shall be, where practical, angled to suit the direction of air flow.

All ductwork shall be adequately supported on hangers and brackets, shall be consistent throughout and shall be positioned and spaced in relation to one another and to the building structure so as to not interfere with any other services and to allow for the required thickness of insulation.

Dampers shall be provided as an integral part of the ductwork system to all branches to effectively balance the system. In addition, the following shall be provided.

- a) At all fan discharges to fine tune air flow to meet design calculations.
- b) At all main supply and extract branch ducts.

All dampers shall comply with BS EN 1751:1999 and shall be suitable for use on Class A & B systems of Eurovent Document 2/2 and test procedures for classes A,B & C (up to 1000pa) of HVCA DW 144

Multi leaf dampers shall be used in rectangular ducts having a short side in excess of 200mm. Unless solely used for isolation they shall operate on the opposed blade principle. All dampers on circular ducts shall be opposed blade type

Butterfly dampers shall not be used at any time

All dampers shall be positioned not less than two metres away from the main duct run on branches. Branches serving single diffusers shall not be shorter than three metres long and shall be re-routed to comply, in any situation where this may arise. In all cases a multi leaf damper shall be provided and sized to effectively regulate the pressure and flow rate to suit the design requirement. Dampers shall be as manufactured by Actionair, their Air Shield range complete with quadrant control mechanism to allow infinitely variable settings but locked in place with wing nut system. The damper shall have visual indication of its setting and upon commissioning completion shall be marked with its commissioned setting

Final connections to grilles and diffusers will be permitted in flexible ductwork compliant with DW144 and to a maximum length only of 500mm Supply air flexible connections where installed shall be fully insulated.

At all connections to louvres, the bottom of the duct shall slope down towards the opening to prevent water entering the system. The inside of the duct shall be coated with black bitumastic paint for a distance of not less twice the height of the opening.

All areas of louvres which are not used as air intakes or discharges shall be blanked off using galvanised sheet suitably stiffened to prevent drumming. The galvanised sheeting shall be painted to match the colour of the louver such that any visible parts match.

General - The ductwork sub-contractor is to include for the following:

- i). Test holes shall be drilled and provided with grommets at pre-determined places as defined by the mechanical sub-contractor's commissioning engineer.
- ii). Fixing all grilles.
- iii). Supplying and fixing all VCD's and fire dampers.
- iv). Installation of all plant, equipment, grilles and duct temperature sensors.

It should be noted that in the ceiling voids there are other services occupying adjacent areas to the ductwork such as pipework, light fittings, trunking and tray. Whilst best endeavours are used to prevent clashes, there are inevitably areas which will require reasonable modification to installed ductwork to accommodate other services. The sub-contractor is to allow within the tender for a number of site made modifications as required. It is important to meet with all relevant trades in areas of particular congestion.

1.2.10 Fire Dampers

Fire dampers shall be located within the thickness of the fire barrier. Where this is not possible, the section of ductwork between the damper and the barrier shall have a fire resistant equal to that of the damper itself and shall be to the complete satisfaction of the local authorities. Refer to DW 145 and BSRIA standard details.

Fire dampers shall be manufactured with stainless steel folding curtain housed within a galvanised steel outer casing with continuously welded corners and spigot connections comply with DW 144 class A, B and C. The Fire Dampers to include a release cassette with memory metal spring, which will release the damper at 72 deg C, the cassette shall also be self-latching reset. Fitted with stainless steel side gaskets to minimise the spread of smoke and other products of combustions, and have an external visual indication of the damper curtain.

Fire dampers shall be tested to and comply with BS EN 1366 – 2 or BS ISO 10294 – 1 to E classification. Dampers shall be approved by the LPCB certification scheme.

Fire dampers to be complete with factory fitted appropriate installation system, suitable for masonry wall, concrete floor or dry wall partition.

Fire dampers to be type Fire/Shield or CSS ES rated Fire dampers as manufactured by Actionair.

Fire/Shield Dampers are designed for application in normal dry filtered air systems. If exposed to fresh air intakes and/or inclement conditions the damper should be subject to a planned inspection programme. Any specialists and/or aggressive applications (e.g. swimming pools) may invalidate our warranty, please refer to Actionair Sales office.

All Fire/Shield Dampers should be tested by competent persons on completion of the installation and at regular intervals not exceeding two years.

Spring operated fire dampers should be tested annually and fire dampers situated in dust laden and similar atmospheres should be tested much more frequently, at intervals suited to the degree of pollution. (All in accordance with BS9999:2008 (Ref 7.4, 43.3, V3.5 and W.1) refers.

1.2.11 Ductwork Insulation

All ductwork on show shall be clad.

All supply and extract ducts/return air ducts shall be thermally insulated to the requirements of part 3 of this specification and shall be class 'O' foil faced and vapour sealed. However, all ductwork on view shall be finished in 'Ventureclad' insulation jacketing system in 'Heritage white' RAL TBC.

1.2.12 Access Openings, Panels and Covers

The Sub-Contractor shall provide and install access panels, doors and covers to the complete new ductwork installation in sufficient numbers to comply with DW144 and to enable full disinfection of the complete ductwork systems. The access openings panels and covers shall comply with DW144 and DW172.

1.2.13 Dampers and test Holes

The sub-contractor shall provide and install Multi-leaf balancing dampers shall be supplied and fitted on all branch ducts, each damper to be complete with manual quadrant control

(option Q) and locking device. Test holes shall be provided for commissioning purposes and shall be complete with grommets and balancing dampers/motorized dampers which shall be as manufactured by Actionair Limited, Joseph Wilson Industrial Estate, South Street, Whitstable, Kent, CT5 3DN, Tel: 01227-276100 and shall be their Air Shield Aerofoil type SPG/Flat oval/circular as appropriate, complete with type Q control option. Where motorized dampers are required, they shall be aerosol type SPG option X (extended spigot).

1.3 HEATING

1.3.1 General

The four existing Viessman Vitodend gas boilers were installed in 2014 and will be retained until the end of their life expectancy. At a later date it is intended that a local district heating system will be connected. Therefore all the radiators and pipes have been sized accordingly based on flow and return temperatures of 55°C/45°C to suit the future system. Most rooms will be heated via radiators however, a certain number of rooms will be heated via coils in the ductwork, air conditioning, or underfloor heating.

The existing flue pipes from each boiler are to be modified to avoid the location of the new AHU as shown on the drawings.

In most spaces the pipework will be exposed in the basement, the ground floor being open to visitors and the public it is preferred that pipes are hidden as much as possible. Therefore, flow and return pipes will mainly distribute in the basement before rising up to serve the spaces on the ground floor. This is illustrated on the issued drawings.

There are both variable temperature (VT) and constant temperature (CT) circuits used in the building, the VT circuits will be used to feed the radiators. The CT circuits will supply LPHW to the heater batteries and AHUs. and the underfloor heating array proposed for the Civic Dining Room (CDR).

At basement and ground floor levels all radiators with the exception of those in R0.52 (to remain as existing) have been specified as Jaga, each radiator model and size has been detailed in the radiator schedule below.

1.3.2 Run around system

The main AHU has coils in the supply and extract sections of the AHU which are to be connected via a run around system of pipework. The interconnecting pipework is to be shall be carried out in copper tube to BS EN 12449:2016 R250 (old Table X) with capillary fittings and valves. The pipework shall be 35mm and shall be circulated utilising a packaged run around coil pump unit.

The unit shall be complete with:

- Mikrofill pressurisation unit
- Expansion vessel
- Pump
- Isolating valves
- Pressure gauges

The circulating pump shall be capable of a flow rate of 0.95kg/s and a pressure drop of 230Kpa to accommodate both coils.

The unit is to be as supplied by:

Harmill Systems Limited
Unit P
Cherrycourt Way
Leighton Buzzard
Bedfordshire, LU7 4UH
Tel: +44 (0)1525 851133

1.3.3 New CT & VT Pumps

The existing secondary heating pumps are to be stripped out and replaced with new. The existing shunt pumps are to be retained. Some of the existing pumps are relatively new and are to be examined to see if they can be reused in the new system, but for the purpose of the tender new pumps shall be included.

LPHW heating pumps shall be complete with non-return valves and shall be controlled for automatic changeover via differential pressure switches as defined in the controls specification.

In the plantroom new pumps will be installed for the constant temperature (CT) and variable temperature (VT) heating circuits.

Adjustment of pressure shall be made on an adjacent commissioning valve which is to be supplied with in line with each pump.

The pumps shall be controlled from the mechanical control panel. Isolation test points shall be fitted on the pump side of the isolation valves on both suction and delivery ports.

Pressure gauges shall be provided on the common pipework either side of the pump sets. They shall be calibrated to suit the system pressures and shall enable the particular pump pressure development to be read at a glance.

CT Heating Pumps

Grundfos MAGNA1 D 32-120 F
Duty = 2.61kg/s @ 65kPa
Single Phase – 0.328kW

VT Heating pumps

Grundfos MAGNA1 D 32-120 F
Duty = 1.37kg/s @ 70kPa
Single Phase – 0.172kW

1.3.4 Pipework Fittings & Valves

The LPHW pipework shall be installed in black medium weight mild steel tube to BS EN 10255 with screwed fittings and valves. All new pipework shall have two coats of red oxide paint applied prior to thermal insulation being applied. **Carbon steel pipework shall not be accepted**

First floor heating to remain and new pipework distribution to reconnect onto it.

Suitable pipe-sleeves where passing through barriers together with cover plates all shall be included and fitted.

All new isolating valves within the ceiling voids shall be ¼ turn lever ball valves, gate valves are not allowed.

No flexible connections shall be allowed.

The heating pipework distribution shall be installed with natural flexibility / expansion bellows as required. The contractor shall incorporate cold draw into the pipework layouts. The contractor shall include for anchor points and guides to suit the pipework installation. Only the general routings of pipework are shown on the drawings and the contractor shall provide the necessary bends etc to accommodate the expansion within the installation and all other bends, elbows etc., required to accommodate the installation within the structure.

Pipe fixings to the underside of structural soffit/s shall be of 40mm Unistrut with 10mm drop rods and Flamco ball type pipe hangers. Unistrut to be fixed to structure using suitable fixings e.g. Redhead wedge anchors and shall not be plugged and screwed. Pipe fittings to walls shall be of the brass standoff type and no plastic clips shall be acceptable

Pipe brackets shall be complete with noise suppression inserts

1.3.5 Radiators and TRV's

LPHW heating pipework is to be predominantly distributed throughout the basement and rise through the ceiling to serve ground floor spaces, the pipes shall feed radiators via drops which are to be recessed into the walls at basement and ground floor levels as indicated on the heating drawing.

Radiators shall be as manufactured by Jaga and shall be of the Linea range as indicated on the schedule below and on the drawings

Radiator Schedule - Basement					
Reference	Room	Manufacturer	Product	Height (mm)	Length (mm)
R01	Zoom Pod R-1.03	Jaga	Linea Plus with DBE	500	700
R02	Zoom Pod R-1.04	Jaga	Linea Plus Twin	350	500
R03	Meeting Room R-1.05	Jaga	Linea Plus Twin	350	600
R04	Quiet Working Space R-1.06	Jaga	Linea Plus Twin	350	800
R05	Co Work Space R-1.01	Jaga	Linea Plus Twin	500	1000
R06	Co Work Space R-1.01	Jaga	Linea Plus Twin	500	1000
R07	Co Work Space R-1.01	Jaga	Linea Plus Twin	500	1000
R08	Co Work Space R-1.01	Jaga	Linea Plus Twin	500	1000
R09	Co Work Space R-1.01	Jaga	Linea Plus with DBE	500	1000
R10	Co Work Space R-1.01	Jaga	Linea Plus Twin	200	1000
R11	Co Work Space R-1.01	Jaga	Linea Plus with DBE	200	1000
R12	Co Work Space R-1.01	Jaga	Linea Plus Twin	200	1000
R13	Co Work Space R-1.01	Jaga	Linea Plus with DBE	200	1000
R14	Co Work Space R-1.01	Jaga	Linea Plus Twin	200	1000
R15	Co Work Space R-1.01	Jaga	Linea Plus with DBE	200	1000
R16	Basement Stairs R-1.07	Jaga	Linea Plus Standard	200	800

R17	Kitchen / Staff Room R-1.15	Jaga	Linea Plus with DBE	200	900
R18	Kitchen / Staff Room R-1.15	Jaga	Linea Plus with DBE	200	900
R19	Kitchen / Staff Room R-1.15	Jaga	Linea Plus with DBE	200	900
R20	A.WC / Shower R-1.21	Jaga	Linea Plus Twin	350	500
R21	WC R-1.16 - R-1.20	Jaga	Linea Plus Standard	350	600
R22	Corridor R-1.25	Jaga	Linea Plus Twin	500	1600
R23	Corridor R-1.25	Jaga	Linea Plus Twin	500	1600
R24	BOH Workshop R-1.26	Jaga	Linea Plus Twin	350	800
R25	BOH Workshop R-1.26	Jaga	Linea Plus Twin	350	800
R26	BOH Workshop R-1.26	Jaga	Linea Plus Twin	350	800

Radiator Schedule - Ground Floor					
Reference	Room	Manufacturer	Product	Height (mm)	Length (mm)
R27	Green Room R0.04	Jaga	Linea Plus Twin	350	800
R28	A.WC R0.05	Jaga	Linea Plus Twin	500	600
R29	WC R0.13	Jaga	Linea Plus Twin	500	500
R30	WC R0.14	Jaga	Linea Plus Standard	500	500
R31	WC R0.15	Jaga	Linea Plus Standard	500	500
R32	WC R0.16	Jaga	Linea Plus Standard	500	500
R33	WC R0.17	Jaga	Linea Plus Standard	500	500
R34	A.WC Baby Change R0.18	Jaga	Linea Plus Standard	500	700
R35	A.WC / CH (Hoist) R0.20	Jaga	Linea Plus Standard	500	500
R36	Meeting / Multi-Function R0.22	Jaga	Linea Plus Twin	350	1600
R37	New Lobby R0.21	Jaga	Linea Plus with DBE	650	1100
R38	New Lobby R0.21	Jaga	Linea Plus with DBE	650	1100
R39	Entrance Lobby R0.24	Jaga	Linea Plus Twin	500	1000
R40	Clean Studio R0.29	Jaga	Linea Plus Twin	500	1100
R41	Clean Studio R0.29	Jaga	Linea Plus Twin	500	1100
R42	Clean Studio R0.29	Jaga	Linea Plus Twin	500	1100
R43	Multifaith Space R0.26	Jaga	Linea Plus Standard	500	500
R44	Messy Studio R0.31	Jaga	LST Tempo Twin	600	1100
R45	Messy Studio R0.31	Jaga	LST Tempo Twin	600	1100
R46	Messy Studio R0.31	Jaga	LST Tempo Twin	600	1100
R47	Messy Studio R0.31	Jaga	LST Tempo Twin	600	1100
R48	WC R0.33	Jaga	Linea Plus Standard	500	500
R49	WC R0.34	Jaga	Linea Plus Standard	500	500
R50	A.WC R0.35	Jaga	Linea Plus Twin	500	500
R51	Corridor R0.27	Jaga	Linea Plus Twin	950	700
R52	Corridor R0.27	Jaga	Linea Plus Twin	950	700
R53	Quiet Room R0.47	Jaga	Linea Plus Standard	500	700
R54	Corridor R0.41	Jaga	Linea Plus Twin	500	1200

R55	WC R0.42	Jaga	Linea Plus Standard	500	500
R56	A.WC R0.46	Jaga	Linea Plus Standard	500	500
R57	Classroom 1 R0.48	Jaga	LST Tempo Twin	600	1800
R58	Classroom 1 R0.48	Jaga	LST Tempo Twin	600	1800
R59	Classroom 1 R0.48	Jaga	LST Tempo Twin	600	1400
R60	Classroom 2 R0.50	Jaga	LST Tempo Twin	600	1800
R61	Classroom 2 R0.50	Jaga	LST Tempo Twin	600	1800
R62	Classroom 2 R0.50	Jaga	LST Tempo Twin	600	1400
R63	Corridor R0.51	Jaga	Linea Plus Twin	500	1000
R64	Kitchen R0.10	Jaga	Linea Plus Twin	650	1200

Radiator Schedule - First Floor					
Reference	Room	Manufacturer	Product	Height (mm)	Length (mm)
R65	R1.01 Lobby/Stairs	Jaga	Linea Plus Twin	500	1800
R66	R1.03 Lift Lobby	Jaga	Linea Plus Twin	500	500

The Jaga Linea Plus DBE range are supplemented with additional electric heating for peak winter periods, these have been chosen as the output is insufficient in some areas at the operating temperatures proposed.

- Note:
- All radiators to have BBOE connections
 - All radiators to be finished in white
 - All radiators to be complete with all necessary brackets

Thermostatic radiator valves shall be fitted to the flow connection of all radiators and they shall be Danfoss RAS-C2 range with horizontally angled bodies. They shall be suitable for two pipe operation complete with 15mm connections.

Return connections to the radiators shall be complete with Danfoss RLV lockshield valves together with drain cocks.

1.3.6 Underfloor Heating

The mechanical sub-contractor shall employ a specialist underfloor heating installer to supply and install the underfloor heating pipes, insulation, manifolds to serve the LPHW heating in the Civic Dining Room (CDR).

The adjacent lobby is to be provided with underfloor heating but the floor area is insufficient to heat this space to 21oC. The space is transient and therefore a lower temperature is acceptable and shall remain uncontrolled and installed as part of the main CDR system

In principle the main contractor shall construct the sub floor foundation. An underfloor heating specialist shall lay the insulation bed, including vertical insulation to the perimeter. The underfloor heating installer shall supply and install the pipework back to the manifold arrangements shown on the plan, manifold has been shown in understairs store on drawing but location is TBC. The final screed shall be installed by others although a cost should be obtained from the underfloor heating specialist to provide the final screed and it should be

discussed with the main contractor if they wish to allow the underfloor heating installer to lay the screed. The compression strength of the insulation is to be suited to the application.

The underfloor heating installer shall supply all underfloor heating piping, insulation and manifold sets. The mechanical contractor shall connect onto the manifold with LPHW flow and return pipework including isolating valves generally as shown on the schematic.

The manifold sets shall be complete with automatic air vents, balancing valves, pressure & temperature gauges, isolating valves, flow protection thermostats, inbuilt bypass and distribution pump.

The manifolds shall be complete with local isolation valves as stated above which are to be set up at commissioning stage to regulate the flow rate accordingly but should also be capable of isolating zones if required.

Temperature control of the CDR shall be achieved via a wall mounted temperature sensor. The BMS system shall be capable of adjusting the individual room temperature via a front end PC. Control signals from the BMS system will be required to the manifold to provide an on/off facility and to indicate when the night time setback facility is required.

A flushing loop shall be provided prior to each underfloor heating manifold.

Upon completion the underfloor heating installer shall return to site in sequence with the commissioning engineer and shall commission their own elements of the underfloor heating.

The underfloor heating shall be provided by:

Geoff Dean
Underfloor Solutions Ltd
Unit 5, Chadkirk Business Park
Vale Road
Romiley
Stockport
SK6 3NE

T: 0161 449 0005
F: 0161 449 9959
E: info@usl-uk.com

1.3.7 Insulation

The mechanical sub-contractor shall employ a specialist insulation sub-contractor to install insulation in accordance with part 3 of this specification. However, all exposed pipework shall be fitted with "VentureClad" finish in a 'Heritage White', RAL to be confirmed by architect.

1.3.8 Water treatment

Upon completion of the system the pipework shall be fully flushed and cleansed with the correct proportion of water treatment to match the existing system.

This process is to be carried out by an independent water treatment specialist who will be required to issue a certificate upon completion.

Upon completion of the system the pipework and plant shall be fully flushed and cleansed with the correct proportion of Corroban 40 and biocide ITA water treatment added.

This process is to be carried out by an independent water treatment specialist who will be required to issue a certificate upon completion.

1.4 DOMESTIC HOT AND COLD WATER SYSTEMS

1.4.1 General

There is an existing 28mm cold water mains that enters the basement via room R-1.01 'Your Trust / Co Work Space', new pipework will then connect to this mains before it enters a break tank located in the R-1.22 plantroom.

The hot water will be generated by an existing ACV water heater that is located in the same room as the proposed storage tank however, the capacity is to be increased with the addition of a HW storage cylinder. From here the hot and cold water will be distributed throughout the building, mainly via the basement to minimise pipework being on show in the ground floor.

The mechanical sub-contractor shall ensure that the hot tap is consistently kept to the left hand tap throughout the project.

No flexible connections shall be allowed.

The water services shall connect to the existing domestic hot and cold water services from the existing locations as noted on the tender drawings.

1.4.2 Combined Cold Water Storage Tank & Booster pump set on stillage

The existing 28mm mains requires an additional storage tank to cope with the new load of the building, the cold water storage tank shall be provided in the basement R-1.22 plantroom, it shall be fed from the mains cold water supply and be a combined with the booster set as a single package. The booster pump set sits below the storage tank to minimise footprint.

The unit specified as Flowtech One piece GRP 1220litres.

Dimensions:

1183mm Length

1183mm Width

2420mm High

The pumpset shall have twin pumps and be capable of a flow rate of 1.2l/s offering 2.5bar outlet pressure.

The whole tank shall be in compliance with the water byelaws. A minimum of 350mm gap shall be provided between any point of the tank and the roof. A Keraflo Aylesbury KB type float valve shall be fitted.

The outlet of the water storage tank shall be located above the inlet of the water booster set to ensure that the water booster set inlet is always flooded with water.

The booster set shall be controlled from its own control panel which will in turn be fed from the BMS system, common fault indication shall be included. The pump set shall be further

protected by level switches fitted in the main water storage tank which will prevent the pumps from operating when there is an absence of water.

The unit shall be supplied by:

Flowtech
Unit 1, Lock Flight Buildings,
Wheatlea Road,
Wheatlea Industrial Estate,
Wigan,
Greater Manchester,
WN3 6XP

Contact: Jon Havard
Tel: 01942 311 119
Email: jon@flowtech.org.uk
Mobile: 07772 428 815

1.4.3 Additional DHW storage

Hot water shall be generated via the existing ACV Heatmaster 35C water heater. An additional vertical direct hot water storage cylinder shall be installed complete with flexi jacket insulation. The unit shall be suitable for a working pressure of 3bar. The vessel shall also be provided with a 3kw immersion heater for emergency use only.

The cylinder shall be provided with the following connections:

- 28mm HWS Flow off the top
- 22mm Safety valve connection off the top
- 22mm primary flow connection
- 22mm primary return connection
- 15mm Immersion heater connection
- 15mm HWS secondary return connection at low level
- 15mm Drain off cock at the bottom
- 15mm temperature sensor connection

The proposed hot water storage cylinder is to be copper or stainless steel with the following approximate dimensions.

Height: 2355mm
Diameter: 780mm

1.4.4 DHW Secondary pump & loading pump

Hot water shall be circulated by a bronze or stainless steel model pumpset. It shall operate on a 24 hour basis and be provided with a timeclock channel to allow the end-user to time adjust time schedules should they wish to. Altitude gauges with cocks shall be provided on the common suction and delivery connections.

The pumps shall be as follows:

Secondary DHWS Pump:

Grundfos UP25-60N 180
Single Phase – 49 watts

VT Heating pumps

Grundfos UP20-07N 150
Single Phase – 48 watts

A spare set of pumps shall be provided for both and these shall be fixed on a wall bracket in the plantroom

1.4.5 CAT5 bib tap

There is to be an external bib tap which will have its own packaged booster set and CAT5 break tank, specified unit is the Flowtech Flowpac SS40 CAT5. The unit will be located in the Zoom pod within its own cupboard and access hatch.

Dimensions:
480mm Width
277mm Depth
850mm Height

1.4.6 Zip Instant Water Boilers

An instant water boiler is to be installed in the Staff Kitchen located in the basement as shown on drawing. The water taps are to be Zip Water Hydrotap G5 Classic Plus Boiling 240/175.

Installation and connection of a Zip HydroTap must be carried out by a qualified person, observing national and local regulations. The taps are to have waste water drainage within 1 metre of the product. HydroTap is air-cooled so discrete cabinetry cut-outs are required for ventilation. As the building is in a hard water area, it is to be provided with a limescale filtration kit.

1.4.7 TMV's

Thermostatic mixing valves TMV3 shall be provided and installed on all WHBs. The mixing valves shall be individually mounted to each WHB to match the flow rate required. They shall be located within vanity units where possible. TMVs shall be Reliance or similar.

Only kitchen sinks and cleaners sinks will have no requirement for mixing valves.

Each valve shall be complete with built in NRV's and in-line strainers on both the cold and hot connections complete with isolation valves. The sub-contractor shall ensure that the water services are thoroughly flushed prior to installation of strainers and valves.

1.4.8 Pipework Fittings & Valves

All water services pipework shall be carried out in copper tube to BS EN 12449:2016 R250 (old Table X) with capillary fittings and valves. Lead free solder shall be used and 'end feed' type fittings will not be allowed. Compression fittings can only be used on chrome plated pipework. No push type fittings would be accepted under any circumstances.

Crimped jointing pipe systems shall be considered suitable for domestic/potable water installations. Pegler/Yorkshire Xpress (or equal and approved). However, a union fitting is

to be installed either side of every valve to enable removal without the need to cut the pipework.

All appliances are to be fitted with local isolation valves which shall be ball valves with PTFE seats and seals and T handle operation as specified in part 3 of this specification. Check valves and strainers shall be installed on the hot and cold to all showers.

All exposed copper pipework shall be chrome plated.

Final connections to appliances in kitchen to be by kitchen specialist.

Pipe fixings to the underside of structural soffit/s shall be of 40mm Unistrut with 10mm drop rods and Flamco ball type pipe hangers. Unistrut to be fixed to structure using suitable fixings e.g. Redhead wedge anchors and shall not be plugged and screwed. Pipe fittings to walls shall be of the brass standoff type and no plastic clips shall be acceptable.

Pipework brackets shall be fitted with noise suppression inserts and vapour blocks shall also be installed on the cold water services pipework

Suitable pipe sleeves and cover plates shall be installed.

The whole installation shall comply with the Water Supply Byelaws and HTM regulations and HSC L8 requirements

1.4.9 Insulation

The mechanical sub-contractor shall employ a specialist insulation sub-contractor to install class 'O' foil faced insulation with colour banding and directional flow indication all in accordance with part 3 of this specification. All exposed pipework shall be fitted with "VentureClad" finish in a 'Heritage white', RAL TBC by architect.

1.4.10 Sterilisation of Water Services

Upon completion, the entire water services installation is to be fully cleansed and sterilised in compliance with local authority requirements and in accordance with BS8558:2015 and BS EN 806.

The sterilisation is to be provided by an independent specialist who shall produce a certificate upon completion.

This section of the works shall be carried out by:

Pennine water treatment services Tel 0161 272 0762 or equal and approved

1.5 SANITARY WARE

The sub-contractor is to install sanitary ware all as detailed on the schedules produced by the Architect and as supplied by the main contractor and as shown on the tender drawings.

The installation is to be in accordance with BS EN 12056-2:2000 and BS5627

All sanitary ware shall comply with the Water Supply (Water Fittings) Regulations-1999

The sub-contractor shall verify the sanitary ware schedule to understand the content and to ensure that the necessary components are included.

The positioning of all appliances shall be identified by the Architect and any installation taking place prior to receipt of information and is found to be unsuitable shall be rectified. Any breakages occurring prior to handover shall be replaced at the sub-contractors expense.

The sanitary ware installation shall comply with NBS specification reference N13 – Sanitary ware appliances and fittings.

The contractor shall include for setting to work and testing all sanitary appliances connected to the hot and cold water services systems

1.6 ABOVE GROUND SANITATION SYSTEMS

All drainage shall be installed fully in accordance with BS EN 12056-2:2000 Gravity Drainage systems inside buildings

The contractor shall also comply with NBS specification reference R11 – Above ground drainage.

Due to the location of certain new appliances on the ground floor the contractor shall supply and install 1No. 'Sanispeed+', 2No. 'Sanibest' and 1No. 'Sanicom 2' waste pumps. The units shall each receive local waste water and shall pump it to high level from which gravity pipework shall route the waste to the nearest drain pipe as shown on the drawings.

Condensate drip trays from A/C units to be connected to soils & waste via a HEPVo trap, contractor shall install a Hepworth HEPVo waste valve (32mm).

Access doors shall be installed in such a position that at all times the door is accessible to enable necessary clearance of the system and where possible on the crown of the pipework. Access doors shall be provided in all vertical drainage pipework just before it connects to the underground drainage services, and at all changes in direction on horizontal pipework. The use of 90° bends on soil pipework is permitted at high level on the floor below where drainage pipework runs through the ceiling void to connect to existing stack positions with access doors at changes of direction, this is to minimise the chances of blockages occurring in the soil pipework. The pipework should also be installed to the correct falls in accordance with BS EN 12056-2:2000 Part 2: Sanitary Pipework, layout and calculation.

All pipework installed shall be inspected by the installer, the main contractor, the consulting engineers and the Maintenance teams on completion of the works and prior to the re-installation of ceiling tiles / IPS panels etc. The installer and the main contractor shall ensure that the pipework is installed to adequate falls, with adequate access doors and with access doors at 90° bends on soils pipes before the installation is offered to the design and client team for inspection. Unacceptable pipework arrangements will be removed and replaced by the mechanical sub-contractor at no cost to the client.

All open ends of pipework and fittings shall be properly sealed off during erection with plastic plugs or plates until such time as sanitary fittings and the like are connected to the system.

Upon completion the mechanical sub-contractor is to fully test the soils and waste system to totally comply with the requirements of the local authority. Air and water flow tests shall be undertaken in accordance with BS EN 12056-2 requirements

The sub-contractor shall inform the Local Public Health Inspector when the parts of the system are ready for inspection and shall make such arrangements as are necessary for the Inspector to be present at such tests.

All traps shall be self-resealing anti-vac / anti-siphon traps and shall be Marley unless specified separately.

1.7 AIR CONDITIONING/COOLING

1.7.1 General

The mechanical engineering contractor shall employ the services of a specialist air conditioning installing, servicing and commissioning engineering contractor who shall carry out all works associated with the comfort cooling systems.

The extent of the cooling includes the digital/IT rooms, the podcast studio, the performance space and the Electrical plant room.

The Digital/IT Studio, Digital Co-working Space, Podcast Room and electrical plant will be fed off a multi-split system and each have their own four-way 600x600mm cassette as detailed on the mechanical cooling drawing. The performance space will be cooled and heated via a duct-mounted DX coil manufactured by SPC.

1.7.2 Split System Air Conditioning

The contractor shall include for the installation of a new split air conditioning system to serve the ground floor digital spaces and a separate system to serve the electrical plant.

Both systems shall comprise of ceiling mounted cassette units that will be mounted exposed or concealed depending on the ceiling type of the room.

The units shall be as manufactured by Mitsubishi Air Conditioning UK, be complete with a 3 year warranty with local wired controllers and BMS interface card.

The indoor units shall be as follows:

Ground Floor

Digital Co Working Studio – Mitsubishi SLZ-M25FA

IT/Digital Studio - Mitsubishi SLZ-M25FA

Podcast Studio - Mitsubishi SLZ-M25FA

This system is to be served from an external Mitsubishi Multi-Split Heat Pump MXZ-3F54VF3

Elec Plant - Mitsubishi SLZ-M25FA

The Elec Plant will be served from an external Mitsubishi Multi-Split Heat Pump MXZ-2F33VF3

Digital Co working studio and IT/Digital Studio will each have their indoor unit exposed, for these spaces the contractor is to include for a cassette collar.

Controls shall be provided local to the light switch in each of the spaces but the controller is to be largely tamper proof programmed only to allow the change of temperature in the

rooms. Overall control shall be provided by a main central panel which shall be accessed by authorised staff only. The system is to be linked to the new BMS.

The Contractor is to include for supplying and installing support brackets for all pipework and associated cabling and containment.

The condensers are to be located externally in the rear courtyard as shown on the drawings.

All builders work is to be carried out by the main contractor.

All units shall be of Mitsubishi Manufacture suitable for use on R32 refrigerant and condensers with energy ratings compliant with BSEN14825:2012 and where possible shall have an A+++ to A rating.

All internal units shall be suitable operation on a 230volt 50Hz electrical supply

Commissioning, testing and demonstration of all the equipment is to be carried out by the Specialist Contractor.

1.7.3 Cassette Collars

In locations where the cassettes are not installed within ceilings and are on view the contractor shall supply and install purpose designed collars to shroud the sides of the cassette units.



These collars are to be supplied by JAC Supplies:

Unit 1 Old Boat Yard Industrial Estate,
Church Broughton Road,
Foston
Derbyshire,
DE65 5PW

Tel: 01283 520008

Email: info@jacsupplies.com

1.7.4 DX Heat pump

There is a ducted DX coil that will provide heating and cooling to the performance space, it shall be linked to two external inverters which shall be Mitsubishi as per the following:

2No. Mitsubishi PUZ-ZM200YKA2R1 Heat pump R32

The inverters are to be supplied with a compatible BMS controller.

The ductwork is to be installed with 1No. reversible DX coil with two built in circuits to cater for the following temperatures at an air flow rate of 1.45m³/s using R32.

- Winter 21oC to 30oC
- Summer 30oC to 14oC

The coils are to be supplied by:

SPC
SPC House,
Evington Valley Road,
Leicester
LE5 5LU
Contact: Fabio Cambundo
Tel: 0116 2498002
Mobile: 07831 788 064
Email: fabio.cambundo@spc-hvac.co.uk

All works shall be installed by a specialist refrigeration contractor including all pipework and associated brackets, controls and interconnecting wiring and condensate drainage.

The contractor is to include for supplying and installing support brackets for all pipework and associated cabling and containment.

The external inverters are to be situated in the rear patio area.

All builders work is to be carried out by the main contractor.

All units shall be of Mitsubishi Manufacture suitable for use on R32 refrigerant and condensers with energy ratings complaint with BSEN14825:2012 and where possible shall have an A+++ to A rating.

1.7.5 Refrigeration Pipework

The Contractor is to supply, install, test and commission all interconnecting refrigeration pipe work between the outdoor and indoor units.

All pipework to be carried out in refrigerant quality soft/medium drawn copper tubing to BS EN 12449 and complete with the appropriate headers and joints.

Pipework is to be carried out by an approved Mitsubishi supplier. The refrigerant engineer assigned to the contract must have an up-to-date Mitsubishi certificate (certificate approval must be submitted prior to installation commencement) and must be in accordance with the BSEN 378 2000.

Longest possible lengths of copper pipe are to be utilised to minimise joints on site.

Appropriate refrigeration installation tools are to be utilised. Dry Nitrogen is to be utilised at all times in the system during brazing.

All pipework (suction and liquid lines) to be insulated with slip on close cell elastomeric pipe insulation (as manufactured by Armaflex or equal and approved) with a fire performance

Class 0 of the 1985 building regulations, having a wall thickness of not less than 13 mm. Externally all pipework shall have a Ventureclad tape covering

After installation of pipework, and prior to sealing of insulation joints and starting of equipment, pipework should be pressure tested. 3 bar test for 3 minutes minimum, then 15 bar for 3 minutes minimum, then 33 bar for 3 minutes minimum, then strength test to 41.5 bar check the system for leaks and deformation, then lower the pressure back to 33 bar and pressure test 24 hours and checked for leaks. Vacuumed/dehydrated to (-752mm Hg) 2 torr, and hold at that setting for 12 hours (minimum)

Refrigerant charge weight must be calculated, to the actual installed length of pipe work in accordance to Mitsubishi recommendations.

The charging should be carried out with an appropriate charging station.

Pipework to be properly fixed and supported at a minimum of 1.5 metre centres and where required should be run on galvanised trays. All pipe work to be labelled with ID number (condensing unit's ref.) at 3 metre intervals.

Joints in copper pipe are to be brazed. Brazing is to be carried out to the requirements of the HVCA Code of Practice - Brazing and Bronze Welding of Copper Pipe and Sheet.

1.7.6 Close Control unit

In the basement there is a picture storage that will be used to hold pieces of artwork, to maintain the desired temperature and humidity level a close control unit shall be installed.

The contractor shall supply and install a free standing Marstair CD3 08 close control upflow unit internally and the outdoor unit is to be a 3ph Marstair CKC30(+) condensing unit. It shall have electronic control for both humidification and dehumidification with two fan speeds and two stage heating

The Marstair unit shall use R407C refrigerant.

The unit shall be linked to the BMS system to monitor faults or filter change.

The system and its supply/interconnecting wiring is to be protected by H.R.C. motor rated types to BS60269 or miniature circuit breakers to BS60898 or local codes having similar time lag characteristics that allow starting of the compressor yet still afford close over current protection under running conditions.

The unit shall be commissioned by a Marstair engineer.

1.7.7 Condensate Pipework

A condensate line is to be installed to each internal unit and from each drip tray. This is to be installed and insulated all as per the standard specification. Minimum size of condensate pipes to be 25mm ABS plastic gravity from each cassette. Drains to run 1:80 min falls as indicated on drawings.

Where the contractor connects the condensate drains into soil vent stacks then the contractor shall install a Hepworth HEPVo waste valve (32mm). In respect of AHU drains and evaporator drains they shall have refillable glass traps.

1.7.8 Commissioning

Commissioning, testing and demonstration of all the equipment is to be carried out by the Specialist Contractor.

1.8 AUTOMATIC CONTROLS

The existing boiler system is to be retained and likewise the existing BMS control panel is to be retained however there are to be some modifications to suit the new installation and there is to be a second panel to accommodate the new ventilation plant.

The existing BMS controls are Ambiflex and the new components are to be controlled by the same system with the existing MF3200 used if there is sufficient capacity. If not then a new controller shall be provided.

Mechanical Engineering Contractor shall employ a controls specialist to carry out the installation of the new and upgraded controls system for control of new and existing mechanical plant items.

The control specialist shall be:

Syntax Controls Ltd
8 Greenway
Higher Crompton
Shaw,
Oldham
OL2 7PY

Contact: John Bardsley
Email: john@syntaxcontrols.com
Mobile: 07788 684885

The contractor shall include for all the plant items to be interfaced with the existing site wide BMS system, including for the provision of new graphics front end updates for the new and existing BMS control panel and associated controls, sensors, actuators etc.

The controls specification shall be read in conjunction with the tender drawings, schematics and schedules which detail the specific components and references.

Note: The Mechanical Engineering Contractor via their specialist controls contractor shall allow for all electrical supplies to be provided via the new BMS control panels within the Plantrooms and shall allow for all wiring and containment to all items of equipment, including the LPHW heater batteries, AHU as well as the external condensers, including local lockable electrical isolators.

The Mechanical Engineering Contractor shall include for the necessary liaison with the specialist to ensure that all plant details are provided to the controls specialist

A general description of operation is listed below however this must be read in conjunction with the Mechanical Services Layout and Schematic Drawings.

Heating

Works to existing control panel

1. Disconnect existing gallery 4 VT pump controls
2. Disconnect existing ground floor CT pumps
3. Use existing main building CT pump control to serve new CT pump (remove felt tip pen 'Museum Fans' from traffolyte label. Pumps shall be monitored by a new differential pressure switch
4. Use existing main building VT pump control to serve new VT pump (remove felt tip pen 'Rad from traffolyte label. Pumps shall be monitored by a new differential pressure switch.
5. Existing VT 3 way valve to be replaced with new controlled via new htg return pipeline mounted temperature sensor and new external temperature sensor.
6. Retain DHWS water heater supply
7. Retain DHWS secondary pump control however linked to new secondary pump
8. Retain Htg pressurisation controls
9. Remove large and small museum fan coil unit supplies
10. Replace item 7 components on facia with new loading pump supply plus new booster pump supply.
11. New booster pump to be fed from panel to be linked to BMS to monitor high and low level pressure switches, a common fault alarm condition shall be relayed to the BMS. A water float switch shall be located in the tank to ensure booster pump does not run dry.
12. Secondary DHWS pump to be operational 24/7
13. Loading pump to be controlled via cylinder mounted temperature sensor operating pump when temp drops below 65oC
14. Add 3kw immersion heater control
15. Add DHWS flow and return pipeline mounted temperature sensors for monitoring purposes.

Controls within new panel

1. Supply 3 way valve to new Main AHU above the toilets to serve LPHW heater battery controlled via a duct mounted temperature sensor after the AHU. Set point temperature to be 21oC but shall have the facility to be adjusted via BMS.
2. Supply 3 way valve to new Classroom AHU above the classroom toilets to serve LPHW heater battery controlled via a duct mounted temperature sensor after the AHU. Set point temperature to be 21oC but shall have the facility to be adjusted via BMS.

3. The underfloor heating system serving the Civic dining room and Lobby is to be supplied with CT LPHW. Locally the underfloor heating system shall have its own circulation pump but control of the main space shall be achieved via a room mounted temperature sensor. The BMS shall control the individual circulation pump to provide LPHW to all of the individual loops together. The Lobby loops shall not be controlled.
4. Supply and install a number of room temperature sensors for monitoring purposes these shall be fitted in the following rooms
 - i. Main entrance
 - ii. Kitchen
 - iii. Clean studio
 - iv. Digital studio
 - v. IT Studio
 - vi. Pod cast room
 - vii. Classroom 1
 - viii. Classroom 2
 - ix. Basement open plan office

Ventilation

Controls within new panel

1. Supply to Main supply and extract AHU fans with inverter control. AHU to be operated via dedicated time channel.
2. Differential pressure switches across AHU fans to monitor operation
3. Capillary temperature sensor on supply air run around coil for frost protection to isolate fan if insufficient temperature
4. Power for run around coil pump, operation dictated by supply air temperature sensor after AHU in coordination with reheater battery. Priority is to recover heat via run around coil and then reheater battery topping up to room temperature.
5. During winter operation of AHU to be sequenced such that VT heating is activated prior to operation of fans.
6. Filters to have differential pressure switched to monitor condition.
7. Fresh air supply and exhaust connections to have motorised dampers to shut when system is off.
8. Supply to Classroom supply and extract AHU fans with inverter control. AHU to be operated via dedicated time channel.
9. Differential pressure switches across AHU fans to monitor operation
10. During winter operation of AHU to be sequenced such that VT heating is activated prior to operation of fans.
11. Filters to have differential pressure switched to monitor condition.
12. LPHW heater battery operated via 3 way valve as described in heating above maintaining set point at 21°C which is to be adjustable

13. Fresh air supply and exhaust connections to have motorised dampers to shut when system is off.
14. The main AHU above the toilets shall provide air with an off coil temperature of 21oC the CDR room and Kitchen are to be heated locally via underfloor heating and radiators respectively. The Performance space is to be provided with inline coils fed from two external heat pumps offering heating and cooling.
15. Control of the Performance space is as described below in the AC section
16. Each of the three areas served from the main AHU are to be fitted with variable air volume control boxes to enable air volume to be adjusted to suit occupancy.
17. The CDR room is to maintain its flow rates as a constant and the supply and exhaust VAV boxes are to modulate in response to changes in flow rate to the other two legs.
18. The kitchen is to control its VAV box on supply and extract via a local controller located in the kitchen which is to be operated by the Kitchen staff to control the flow rate through the canopy. The controller is to have on/off facility and variable speed. The VAV boxes are to be supplied by Trox as described above and are to be operated via 24v signals.
19. The Performance space VAV boxes shall operate according to an air quality sensor to respond to a room with minimal occupancy to full occupancy.
20. Whilst the Performance space air volume is controlled based on the air quality sensor this shall be overridden if the temperature in the room cannot be maintained due to lack of air volume. BMS to determine priority.
21. An off coil temperature sensors shall be mounted in the ductwork serving the space for monitoring purposes only.
22. VAV boxes on each leg are to modulate in response to any variation that may occur due to the above described controls. To achieve this pressure sensors shall be installed in the ductwork which shall be used during commissioning to determine all permutations of air flow condition and shall be programmed accordingly.
23. The AHU supply and extract fans are to modulate their speed accordingly.
24. The Performance space is heated and cooled via the air system. The drum louvres have motorised blades with 24v actuators which are required to switch form heating to cooling mode to ensure correct air distribution. The operation of this is to be either one or the other and not modulating. Control shall be dictated by the off coil temperature from the heat pump. Air distribution is to be set for cooling when the off coil temperature from the heat pump is less than 17oC. Any temperature above this shall switch the drum louvre blades to heating mode.
25. CDR toilets to be provided with a twin toilet extract fan which is to have its own time channel. Fan failure shall be monitored via a differential pressure switch which shall switch fans on failure.
26. Green room toilet to have a supply to local Ventaxia fan. Fan to be controlled via ceiling mounted PIR with run on timer.
27. The Clean studio Lossnay is to be provided with its own timechannel. Fan failure is to be monitored via a differential pressure switch.

28. Toilets and mini kitchen to be provided with a twin extract fan which is to have its own time channel. Fan failure shall be monitored via a differential pressure switch which shall switch fans on failure.
29. Basement toilets to be provided with a twin toilet extract fan which is to have its own time channel. Fan failure shall be monitored via a differential pressure switch which shall switch fans on failure.
30. Caldair unit serving studios/kiln to be provided with power to the supply and extract fans which are to have its own time channel. Fan failure shall be monitored via a differential pressure switch
31. The kitchen Ventaxia fan in basement is served from a local supply and not part of the BMS
32. Basement rear internal offices to be provided with a Lossnay fan which is to have its own time channel. Fan failure shall be monitored via a differential pressure switch Fan to operate during normal working hours on low speed. Boost switch provided in room for occupancy control to switch fan to high speed. Boost switch to operate for one hour only and then revert back to normal speed.

Air conditioning

Controls within new panel

1. The Performance space temperature is to be controlled via a twin heat pump linked to two internal duct mounted coils. Power supplies for the external heat pumps are to be part the electrical contractors works and both are three phase. The BMS is to utilise the internal temperature sensor to determine if heating or cooling is required and shall regulate the off coil temperature accordingly. The two heat pumps shall be sequenced accordingly to load via the Mitsubishi controller.
2. The AC unit in the electrical room is to be operated 24/7 via local electrical supply and controller not part of BMS.
3. The 3No.studios at ground floor level are to be provided with a Mitsubishi heat pump system serving cassettes. Heat pump system is to be provided with a time channel to operate on a daily basis but local control shall be via wall mounted controllers
4. The Picture store is to be served via a Marstair close controlled unit which is to be operational 24/7 and controlled via its own controller. The unit is to report fault condition or filter change requirement to the BMS. A Temperature and humidity sensors shall be provided in the room for monitoring purposes. Temperature and humidity shall be reported on a monthly basis to the client in an format to be agreed.

Other items

1. The Zip water boiler in the staffroom is to be supplied and controlled locally
2. The booster break tank serving the external bib tap is to be supplied and controlled locally
3. The supplementary heating element in the basement radiators are to be supplied locally
4. The saniflo pumps are to be supplied and controlled locally.

It is intended in the future to refurbish the first floor and in doing so it will involve additional controls for the heating and ventilation. The new control panel shall have space to accommodate these new controls.

The BMS specialist shall install the control panel with the new functions linked to the existing panel and shall update the system graphics on the front end.

General

1. The BMS front end should collate all of the various energy meter readings throughout the building including the electrical meters within the distribution boards.
2. A link shall be provided to the smoke damper control panel to ensure that damper status is visible via the BMS front end.
3. BMS graphics to be issued for approval.
4. Provide run and trip lamps for all equipment and a panel lamp test button.
5. Signal from building fire alarm panel to shut down the plant.
6. Modbus electric meters within local distribution boards shall be provided as part of the electrical services installation and the BMS shall connect each sub-meter to allow electrical energy consumption to be monitored. The locations of the sub-meters shall be agreed with the electrical sub-contractor.
7. Commissioning to be carried out by controls specialist.
8. Control panel wiring diagrams are to be issued for approval prior to manufacture of panel.
9. All equipment shall be clearly labelled

The mechanical contractor shall include for all mechanical wiring to be installed.

Electrical Wiring

Conduit

Shall comply in all respects with BS4568 Parts 1 and 2. To be heavy gauge welded screwed galvanised steel type. All conduits to be free from internal burrs. The ends of all conduit lengths are to be reamed to a smooth finish.

No conduit of a smaller diameter overall than 20mm to be used.

All surface installed conduits are to be securely fixed by means of 'Hospital' type distance saddles.

Manufacturer : Walsall Conduits Limited, Barton Conduits or equivalent and approved.

Conduit Boxes

All boxes to be galvanised. Unless used in association with direct fixed equipment, all boxes are to be fitted with a steel cover lid fixed with brass screws and, where there is a possibility of moisture entering the boxes, they shall be provided with suitable water tight gaskets.

Standard circular conduit boxes shall be of malleable iron for all surface work or pressed steel where concealed in the building fabric. Male brass bushes and couplings shall be used for all adaptable or switch box entries.

Manufacturer : Walsall Conduits Limited, Barton Conduits or equivalent and approved.

Uni-Channel

Shall comply to BS6949 pre-galvanised finished in standard lengths of 3 metre or 6 metre. Channel sizes to be either 41mm x 41mm or 21mm x 21mm section.

All fixings and accessories to be as per manufacturers recommendations.

Manufacturer: Unistrut Ltd or equivalent and approved.

Cabling

A) LSZH Insulated, Non Sheathed (Mains and Final Circuit wiring)

Single core PVC insulated only 450/750-volt grade cables.

Ref - 6491B Cable (H07Z-R) LSZH (Low smoke Zero Halogen) manufactured to BS7211/BS EN 50525-3-41. The cable will be of the stranded plain annealed compacted circular copper conductor, low smoke and zero halogen (LSZH) outer sheath. 450/750 volts grade to BS7211/BS EN 50525-3-41. Acid gas emission to BS EN 50267 (IEC60754), smoke emission to BS EN 50268 (IEC 61034) and flame propagation to BS EN 50265 (IEC 60332), low smoke and zero halogen (LSZH).

B) XPLE/SWA/LSZH Steel Wire Armoured (Sub-main wiring)

Ref -: Mains LSZH manufactured to BS6724. The cable features stranded plain annealed copper conductors, XLPE insulated, low smoke and zero halogen (LSZH) extruded bedding, galvanised steel wire armour, low smoke and zero halogen (LSZH) outer sheath. Black. 600/1000 volts grade to BS6724. Acid gas emission to BS EN 50267 (IEC 60754-1), smoke emission to BS EN 50268 (IEC 61034) and flame propagation to IEC 60332-1, IEC 60332-3, BS EN50265, Category C; BS EN 50266, low smoke and zero halogen (LSZH).

They shall be c/w manufacturers recommended and approved indoor & outdoor type cable terminations to be manufactured in accordance with BS6346. Earth type rings shall be installed with each termination and bolted to the termination point accordingly accepting and extending the same size earth cable to the earth connection point within the equipment.

Manufacturer: Prysmian cables Ltd or AEI cables Ltd to BS6724. (New harmonised coloured conductors).

C) FP 200 plus Cabling

Cable Specification: Enhanced Cable Fire Alarm Cable manufactured to British Standards BS5839 and BS7629. The cable will have plain annealed copper conductors, enhanced silicon rubber insulated, enhanced aluminium/polyester tape screen, tinned annealed copper earth wire, enhanced low smoke zero halogen outer sheath. Red. Manufactured to meet the Enhanced standard of BS5839-1 2002 +A2:2008 Clause 26.2e Enhanced and also the requirements of BS8434 - 2:2003 120 minutes and BS EN 50200 Class PH120. Fire resistant to BS7629-1:2008, BS6387:1994 clause 11 CWZ, halogen emissions to BS EN50267-2-1:1999 and low smoke standard BS EN 61034-2:2005

Accessories to be of the same range and matching colour.

Reference: FP200 Plus
Manufacturer: Pirelli Cables.

D) Flexible Cabling

Ref: 3183B (New harmonised coloured conductors)

Cable Specification: 3183B Cables, Zero Halogen Flexible Cords (HO5 ZIZI-F)-manufactured to BS EN50525-3-11. The cable will have plain annealed copper conductors, Low smoke and zero halogen (LSZH) insulated, low smoke and zero halogen (LSZH) outer sheath. Black or white. 300/500 volts grade BS EN 50525-3-11 Harmonised code HO5 ZIZI-F. Acid gas emission to BS EN 50267-2(IEC 60754-2), smoke emission to BS EN50268 (IEC 61034) and flame propagation to BS EN 50265 (IEC 60332-1).

Note: Where the thermal temperature exceeds cable 85°C, silicon runner glass braided flexibles ref: 2793D to BS 6500 shall be used.

Manufacturer: Prysmian Ltd or AEI Ltd (only)

E) Flexible Conduit

Galvanised steel flexible, liquid tight type tubing, having low acid, LSZH covering overall, complete with externally threaded clamp pattern brass adapters.

Manufacturer: Kopex type LT-T-LFH

or equivalent and approved

General Method of Installation

The method of installation of services to accommodate the, Mechanical Plant Wiring and Specialist Plant supplies shall be by a fully contained rewirable system.

The Mechanical Engineering and Specialist BMS Controls Sub-Contractor shall carefully plan their cabling routes to each of the areas considering all of the building structure and fabric restraints.

In general wiring systems shall comprise of 6491B (LSZH) type singles and belden screened wiring cabling installed within galvanised steel trunking and conduit systems and extended to accessory positions in galvanized steel conduit systems.

Cabling to services within the Plant areas shall all be run in surface mounted galvanised steel conduits extended from the adjacent trunking systems.

Careful consideration of all conduit runs is required by the Mechanical Engineering and Specialist BMS Controls Sub-Contractor to ensure co-ordination with the other services and to overcome the restraints within the building structure.

Flexible conduit shall be used in no longer lengths that 1 meter and shall be only to permit final connection to the various items of electrical equipment.

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1.9 TESTING AND COMMISSIONING

The Contractor shall include for the testing and commissioning of all Works in line with details given in parts 2 & 3 of the standard Specification.

Commissioning with respect to all systems shall be carried out to the approved configurations identifying correct operation of each programmed function. Commissioning of specialist systems installed as part of the Contractor's works shall be carried out by the particular specialist contractor in conjunction with the electrical contractor.

The mechanical contractor shall give the Consulting Engineer 7 days notice with respect to final witness testing and shall provide all necessary access equipment throughout the contract to enable all works to be inspected by the Consulting Engineer.

Final commissioning data shall include all programmed functions and results and shall be included along with the relevant NICEIC Certificates all as detailed in section B01 but in fourfold (not three) within the Operating and Maintenance Manual.

1.10 PROVISION OF RECORD DRAWINGS

1.10.1 General Documentation

The Sub-Contractor shall supply to the Services Consultant, as a pre-requisite to Practical Completion, comprehensive record documents in uniform indexed bound sets. The Sub-Contractor is advised that great importance will be placed upon the quality, accuracy, clarity and completeness of the record documents and upon their being made available promptly.

The Sub-Contractor shall demonstrate from time to time, as required by the Services Consultant throughout the execution of the Works, that adequate and accurate records are being kept such as will ensure the ultimate completeness and accuracy of the record documents and that the record documents are themselves being progressively compiled as the work on site proceeds.

1.10.2 Scope of Record Documents

Record documents shall comprise all as described in this Specification, the following:

- Record Drawings and Schedules
- Operating and Maintenance Instructions

All record documents shall be provided in triplicate and be adequate for the following purposes:-

- a) to provide a comprehensive reference source about each installation
- b) to provide a basis for the correct and efficient operation of the installed plant and system
- c) to serve as an information base and detailed guide for the effective and efficient maintenance of each installation
- d) to serve as a basis for staff training in the operation and maintenance of each installation
- e) to serve as a basis for safety awareness

The record documents shall be correlated so that the terminology and the numerical and/or other references used are consistent with and similar to those used in the physical identification of component parts of the Works

One complete set of all record drawings in AutoCAD 2021 (or later) format on CD, and three sets of white prints shall be available at the contract completion date for handover to the employer.

All record drawings shall be clearly marked "RECORD DRAWING" in 19mm text. If the Sub-Contractor fails to comply with these requirements, the Services Consultant shall arrange

for the records to be prepared elsewhere and the whole of the costs involved in this, including all costs of surveying, printing etc, shall be borne by the Sub-Contractor.

1.10.3 Operating and Maintenance Instructions

Operating and Maintenance Instructions shall be provided by the Contractor and shall comprise the following as applicable (all contained in volumes strongly bound in flexible covers and suitable for heavy usage over a long period) written to be read in conjunction with the Record Drawings, Diagrams and Schedules:

- 1) A general description of the scope, purpose and manner of working of each system of automatic controls and/or monitoring instruments
- 2) A detailed description of the scope, purpose and manner of working of each system or apparatus forming part of the Works
- 3) Data on general design parameters and associated normal operating temperatures, pressures etc, based on the commissioning activity
- 4) Testing and commissioning records clearly cross referenced to system components
- 5) Clear and comprehensive instructions for the starting up, running and shut down of each system or apparatus
- 6) Clear and comprehensive instructions for dealing with emergency conditions for each system or apparatus
- 7) Instructions in respect of any precautionary measures from time to time necessary (e.g. against bacterial contamination, corrosion or freezing)
- 8) Instructions in respect of the care of apparatus normally subject to seasonal disuse
- 9) Instructions as to the nature, extent and frequency of servicing necessary to properly maintain the Works in safety and efficient condition and as to the materials to be used for the purpose. This information may be supported in detail, but not replaced by, maintenance instructions provided by the suppliers or particular component apparatus
- 10) The names and addresses of suppliers of all major components of the Works as may potentially be required to obtain spare parts or replacements, and 24 hour maintenance call-out

Copies of manufacturer's data shall be supplied with respect to the nature, type and method of operation of individual pieces of equipment, together with their detailed maintenance instructions. Such data, in the form of individual booklets and the like, shall be indexed and cross referenced to the Operating and Maintenance Instructions and presented suitably protected in box files or folders. The covers shall be printed with a specific fascia clearly indicating the names of the Project and Client and shall be to the approval of the Services Consultant. Each section of the manual shall be divided by a stiff divider of the same size as the folder. The divider shall be labelled as to the section of the manual which follows it.

All written instructions within the manual shall be typewritten.

SECTION TWO - GENERAL CONDITIONS / PREAMBLES

2.1 TENDER INSTRUCTIONS

The tenderer is to complete the Tender Breakdown sections 4.1, 4.2, 4.3 and 4.4 and shall prepare a quotation based on these documents which are to be read in conjunction with the Construction partner's preliminaries.

The tender is to be a fixed price on a domestic sub-contract basis, with a base date for starting and completing the works as indicated in the Preliminary details and full allowance shall be made for:-

- a) All hoisting, lifting and scaffolding, etc. required
- b) The supply and fixing of all brackets and supports including the drilling etc. of the structure

Full allowance shall be made in the Contractors estimates for the supply and fixing of all steelwork and supports for the support of pipework, cable trays and trunkings and ductwork, etc. throughout the building and the plant areas. The position and arrangement of any steel frames shall be agreed with the Construction partner prior to manufacture or installation.

If the contractor cannot tender for any part(s) of the work as defined in the tender documents, he must inform the Construction partner as soon as possible, defining the relevant part(s) and stating the reasons for his inability to tender. All exclusions shall be clearly indicated on the relevant tender return.

The Contractor's price shall be fully broken down into the various phases and sub headings of the specification. The Tender shall be provided in an itemised Summary Form separately from the building works.

The Contractor shall provide within 2 weeks of being appointed to carry out the works, 2 copies of the schedule of rates adding up to the total tender sum.

The Schedule of Rates is to be completed by the Contractor and approved by the Construction partner before the final acceptance of the Contractors tender. The Schedule of Rates should cover all items being used on the Contract by the Contractor. The schedule of rates shall be submitted within 14 days of so being requested to do so.

The submission of the above schedule does not remove the Contractors responsibility for the accuracy of the tender and the Contractor shall be deemed to have included for all materials and labour, etc, for the complete installation as detailed in the tender specification and drawings.

All variations during the contract shall be based on the prices indicated within the schedule of rates submitted.

In addition to any other information requested within the general contract conditions applicable to this tender, the following information must be detailed in the appropriate appendix by the Contractor at the time of tender:

- a) Contractors shall detail the manufacturer's name and catalogue reference or type, and the expected delivery date for all items of plant and equipment on which their tender offer is based

The contractor (whether their tender is accepted or not) and any other recipients of the specification and documents (whether they submit a tender or not) shall treat the details of the specification and drawings, etc, as private and confidential and shall not reproduce same without the permission of the Construction Partner

In addition to and at the same time as the tender for the works as defined in the tender documents, the Contractor may, at his discretion, submit alternative manufacturers or suppliers for consideration. Alternatives which would involve significant changes to other work shall not be considered.

Such alternative(s) must include all additional costs arising from necessary changes to the details of the installation, including changes to the design and drawings, as well as any associated ancillary equipment items.

Such alternative(s) is/are deemed to be alternative tender(s) and each must include a complete and precise statement of the effects on cost and programme and submit full details with their tender.

Full technical data for each such alternative must be submitted to the Construction partner before the execution of the contract together with details of any consequential amendments to the design and/or construction/installation of other parts of the Works. The employer does not undertake to accept alternative manufacturers or suppliers

Where the Contractor proposes to sublet any portion(s) of the Contract Works a list must be submitted before the execution of the contract.

The list shall define such portion(s) and give, for each, the name and address of the proposed Sub-subcontractor.

Alterations and qualifications to the specification must not be made without the written consent of the Construction partner. Tenders containing such alterations or qualifications may be rejected. Costs relating to items in the specification which are not priced shall be deemed to have been included elsewhere in the tender.

The Employer and his representatives offer no guarantee that the lowest, or any tender, shall be recommended for acceptance or accepted and shall not be responsible for any cost incurred in the preparation of any tender.

The details within the Specification are performance details only, the drawings produced are guideline details only and the working drawings and associated installation is the total responsibility of the contractor who may be requested to enter into a Collateral Warranty.

If any detail is not clearly shown, or any discrepancy occurs between the drawings and the specification, the Contractor is to ask for instructions before proceeding. Work completed due to such discrepancy, or affected by it, shall, if the Consulting Engineer so directs, be removed and redone at the Contractor's expense.

Dimensions should not be assumed or scaled from the drawings. The contractor shall check the documents and the page numbers and if there are any missing or if any figures are indistinct, then the Consulting Engineer shall be notified. No subsequent claim for loss consequent upon the sub-contractor's failure to comply with this clause shall be entertained.

This summary is for guidance only for the Contractor in the preparation of their tender and no omission from the summary or from the other sections of this document shall relieve the Contractor from their obligation to carry out the works in accordance with relevant documentation and the specification.

The engineering services must comply fully with all relevant EU standards, NHS Standards, British Standards, Codes of Practice and local bylaws applicable to the site.

The specifications and drawings are issued to indicate agreed principles of the system design, design criteria and the client's requirements. The drawings and specifications do not attempt to detail every system component and it is the responsibility of the contractor to ensure that all items necessary to meet the requirements of the specification, design intent and the employer's requirements are included within their costs.

All communication, including distribution of correspondence, drawings and other information between the design team and the contractor employed to carry out the works shall be via the Employer, or his appointed representative.

In the event of there being any discrepancies between the specification and the schedules, the conditions of contract or the drawings, or any other documents issued in connection with this contract, the sub-contractor is to point out these to the Consulting Engineer prior to submitting their tender, and to obtain the Consulting Engineer's instructions as to exactly what is required. Failure to do this shall not relieve the sub-contractor of the obligation to execute such items in accordance with the Consulting Engineer's intentions as part of the contract and without any extra payment.

The Contractor shall make an offer for the Works on the above basis and shall be required to comply with the following conditions detailed in this specification.

The following documents are to be read in conjunction with this specification.

1. Specification for this contract, prepared and issued by Steven A Hunt & Associates
2. All drawings listed within Section One of this specification, prepared and issued by Steven A. Hunt & Associates
3. Drawings prepared by the Architect and Structural Engineer in connection with the

Main Building Contract and showing precise details and arrangements of the building construction, are available at their offices and can be viewed by arrangement if required

4. Room data sheets prepared by the Architect
5. Preliminaries details
6. The current appropriate British Standard / European Standard Specification & Codes of Practice relating to the materials and installation methods relevant to the works described hereafter
7. The current Building Regulations
8. Control of pollution act, Environmental Protection act, Clean Air act and the requirement of the local environmental health officer
9. Requirements of the Local Authority and the licensing officer
10. National Inspection Council (NIC) for Electrical Installation Contracting (EIC)
11. The CDM Regulations
12. Control of Asbestos Regulations
13. The Health & Safety at Work Act
14. The Office Shops and Railway Premises Act
15. The Factories Act
16. Noise at work regulations
17. The Electricity at work regulations
18. Regulatory Reform (Fire Safety) Order
19. Fire Precautions Workplace (Amendment) Regulation
20. BS 7671: Requirements for Electrical Installations. IET Wiring Regulations. Current edition and all subsequent amendments
21. Recommendations, guides and technical memoranda published by the Chartered Institute of Building Services Engineers
22. Chartered Institute of Building Services Engineers Lighting Guides and associated publications by SLL
23. BSRIA Publications

24. Institution of Lighting Engineers (ILE) Guidance Notes
25. BSRIA Commissioning Guides 1/91, 20/95, 1/88.1, 3/89.3, 1/2001, 2/89.2, 2/89.3, 5/2002 and AG16/2002
26. BRE Publications
27. Building Bulletins
28. The Water Supply Regulations
29. Provision and Use of Work Equipment Regulations
30. The Lifting Operations and Lifting Equipment Regulations
31. The Gas Safety (Installation & Use) (Amendment) Regulation
32. HSE Approved Code of Practice (ACoP) and guidance L8, "Legionnaires disease; The control of legionella bacteria in water systems"
33. BRE DIG 474 "HOB0 protocol – Handover of Office Building Operations".
34. The Gas Safety (Installation & Use) Regulation
35. The Lift Regulations : EN81-20/2014, EN81-50/2014, EN81-70, EN81-72, EN81-72
36. Industry good practice
37. All other statutory requirements and local by-laws that maybe applicable
38. The requirements of the electricity, gas, water, drainage and telecommunications utility providers

Should any query arise regarding the interpretation of the tender/contract documents, then the Construction partner shall have the final ruling.

The services shall also comply with the following Regulations, Codes of Practice, Byelaws and Design Data:-

- i). All statutory and Local Authority Regulations and Byelaws
- ii). Water, Gas, Electricity, Fire Officer, Environmental Health Regulations and Recommendations
- iii). Current editions of British Standard Specifications and Codes of Practice
- iv). Chartered Institution of Building Services Engineers current recommendations with respect to design criteria and system commissioning codes

- v). BS 7671 IEE Wiring regulations (Incorporating all amendments)
- vi). The Institute of Plumbing – Plumbing Services Design Guide
- vii). Health and Safety At Work Act including all Regulations and Statutory Instruments issued by the Health and Safety Executive. The Construction (Design and Management) Regulations shall also be complied with
- viii). HVCA specifications and Guides
- ix). BSRIA Commissioning and testing documents, Design documents, Electrical Design guides and Health and Safety Guidance documents
- x). HSC L8 Legionnaires' disease: The control of legionella bacteria in water systems

2.2 CONTRACT DUTIES

This document details the contract requirements for the provision of a complete and fully functioning mechanical /electrical services installation, which is fit for purpose, fully integrated and interfaced with the building and the other systems present. The contract includes but is not limited to: -

- a) Supply of all management, administration, engineering skills, supervision and labour
- b) Co-ordination and integration with the building and other systems. The Mechanical / Electrical Contractor shall make an allowance within their tender for coordination of the all services
- c) Functional interfaces between the mechanical and electrical installation and the building systems
- d) Provision of all design working and coordination and installation drawings and calculations
- e) Provision of builders work drawings
- f) Supply, installation and support of all plant, equipment, materials, fixtures and fittings
- g) Provision of controls and wiring diagrams and drawings and associated electrical work
- h) Testing and commissioning and witnessing of systems to Engineer
- i) Provision of Manufacturers drawings
- j) A demonstration of the systems and the provision of user training
- k) Repair of defects and faults in the systems or equipment during the guarantee period
- l) Provision of all samples at no cost to the project
- m) Provision of a building log book
- n) Training of clients staff
- o) Provision of Record drawings, information and maintenance manuals

The entire works shall comply with the requirements of this specification, all applicable standards, accepted good industry practice and be fit for purpose.

2.3 FORM OF CONTRACT

The form of contract and contract conditions shall be issued as a separate document by the Construction partner

Any conflict in form of contract and contract conditions between the above and this document shall be drawn to the project quantity surveyors attention within the tender period.

The contractor shall take note of the programme enclosed within the tender documentation.

The Contractor shall make due allowance within their tender for any lack of continuity of work caused by this programme.

The entire works shall comply with the requirements of this specification, all applicable standards, accepted good industry practice and be fit for purpose.

2.4 DUTIES OF THE CONTRACTOR

The Contractor shall execute the whole of the works to meet the requirements for the systems detailed in this specification. The installation shall comply with all relevant legislation and industry standards and recommendations and with accepted good practice.

The Contractor shall be responsible for the supply and installation including all warranties for the project.

The Contractor shall supply the management, administration, engineering skills, supervision and labour necessary to complete the works in a professional manner.

The Contractor shall ensure that the systems installed under their works are coordinated and integrated with the building and other systems present and that they are interfaced as necessary to ensure the correct operation of the building systems as a whole.

The Contractor shall submit all information, drawings and samples as soon as practicable, and in any event to allow adequate time for Construction Partner comments and to comply with the requirements of the Contract programme.

The Contractor shall provide all builderswork information necessary to accommodate the works within the building and its structure. This includes the following:

- a) Plant and equipment accommodation schedules
- b) Plant and equipment dimensions weights and dynamic loading
- c) Acoustic information relating to the plant and equipment
- d) Vertical and horizontal ducts, risers and hole sizes and positions

The Contractor shall supply and deliver all materials, plant and equipment to site, unload, store and hoist and place in position, fix and support, erect and connect, watch and protect during the Contract.

The Contractor shall test, commission and set to work all installations, materials, components and plant in accordance with this specification.

The Contractor shall demonstrate the systems and provide user training in accordance with this specification.

The Contractor shall provide and maintain accurate installation records on site in accordance with the specification

The Contractor shall provide record information and maintenance manuals in accordance with this specification.

The Contractor shall guarantee the complete works for a period of twelve months from the date of practical completion and repair defects and faults in the systems or equipment during this period in accordance with this specification.

The successful Contractor shall be required to provide a list of emergency telephone numbers at which responsible members of their organisation may be contacted at all times in the event of any emergency.

Where specific requirements are quoted herein they must be adhered to and in all other cases designs are to be based on standards not less than those covered by the current edition of the Publications indicated in this Specification and local and statutory requirements, Building Regulations, Building Notes (HBN's) and Technical Memoranda (HTM's).

The successful Contractor after submission of tenders shall be required to furnish to the Construction Partner the whole of their installation and working drawings for comment and in the event of these requiring to be modified to comply with the foregoing such modifications shall be effected without increase of the tender price quoted.

After tender, the successful Contractor shall be required to lodge with the Construction Partner a complete set of the draft installation and working drawings as referred to above for permanent retention. Following comment of the basic drawings duplicate copies of the final drawings are then to be forwarded to the Construction Partner for comment. After comment, up to 3 sets of drawings are to be forwarded to the Construction Partner for general distribution. These copies are in addition to those that shall be required for the Contractor's own use. The release of the installation drawings to the Construction Partner in no way relieves successful Contractor of their responsibility for the design and operation of the systems.

2.5 CONSTRUCTION (DESIGN & MANAGEMENT) REGULATIONS 2015

All aspects of the Construction shall comply with The Construction (Design and Management) Regulations 2015 (CDM). The Contractor shall submit a CDM competence statement as required by the regulations.

The contractor shall allow for compliance with all aspects of the regulations and in particular:

- a) Implement adequate management systems and processes for Health and Safety which proactively seek to prevent accidents

- b) Ensure that those employed on the project have been properly trained in Health and Safety and are fully aware of their responsibilities under the CDM Regulations
- c) Allocate sufficient resources to the project to enable the duties to be carried out correctly

The Contractor shall provide method statements and risk assessments relevant to their duties under the contract and shall submit all supplementary information for the Health and Safety File as required by the Principle Designer

2.5.1 Health & Safety Information

The contractor shall submit a statement with the tender describing the organisation and resources which the contractor proposes and undertakes to provide to safeguard the health and safety of operatives, and of any person who may be affected by the Subcontract works, including:

- A copy of the contractors health and safety policy document, including risk assessment procedures
- Accident and illness records for the past five years
- Records of previous Health and Safety Executive enforcement action
- Records of training and training policy
- The number and type of staff responsible for health and safety on this project with details of their qualifications and duties

2.5.2 Risks to Health & Safety

The contractor shall submit a statement with the tender describing any significant and unavoidable risks which may arise as a result of carrying out the contract works and the measures proposed to safeguard the health and safety of operatives and of any person who may be affected by the contract/works.

2.6 DEFINITIONS

2.6.1 Technical Definitions

The definitions of technical terms associated with the engineering services installations are those included in:

CIBSE, IOP and BSRIA Technical Publications

Loss Prevention Council - Rules for Automatic Sprinkler Installations

BS 7671 - Requirements for Electrical Installations (IET Wiring Regulations)

British Standards, including Codes of Practice

Associated Statutory Acts

Where used in the documentation the following definitions apply:

Duct: An enclosed space specifically intended for the distribution of services, with direct access for personnel.

Trench: A covered horizontal service space in the floor or ground with access from above.

Cavity: A space enclosed within the elements of a building within which services are installed, e.g. the space between ceiling and floor above. Refer also to Building Regulations.

System: System means all equipment, accessories, controls, supports and ancillary items, including supply, installation, connection, testing, commissioning and setting to work necessary for that section of the Works to function.

Services: Services means the inclusion of one or more systems.

Service Areas: Includes areas within a building with limited finishes such as loading bays, car parks etc.

Exposed Services: Includes installations within plant rooms, outdoors or unprotected within service or occupied areas.

Concealed Services: Includes installations within ducts, trenches or cavities.

References to BSI documents are to the versions and amendments listed in the British Standards Catalogue and in subsequent issues of BSI Update Standards.

Manufacturers' references are those current at the time of Tender.

References mean the particular product as specified in the manufacturer's technical literature current at that time.

2.6.2 Drawing Definitions

Sketch drawings, schematic drawings, detailed design drawings, coordination drawings, installation drawings, installation wiring diagrams, shop drawings, manufacturer's drawings, manufacturer's certified drawings, record drawings, builder's work drawings are as defined in the BSRIA / BE4 Design Framework for Building Services

a) Tender Drawings

The tender drawings show the general arrangement of the Engineering Services to be provided and the inter-relationship of the Works with work to be installed by others. Tender drawings shall not be used as installation or working drawings.

b) Sketch Drawings

Line diagrams and layouts indicating basic proposals, location of main items of plant, routes of main pipes, air ducts and cable runs in such detail as to illustrate the incorporation of the Engineering Services within the project as a whole.

c) Schematic Drawings

A line diagram describing the interconnection of components in a complex system. The main features of a schematic drawing are as follows:

- A two dimensional layout drawing with divisions to show the distribution of the system between building levels. Or an isometric style layout indicating the distribution of systems across individual floor levels

- The drawing is not necessarily constructed to scale. Include all functional components which make up the system, i.e. plant items, pumps, fans, valves, strainers, terminals, electrical switchgear, distribution and components
- Symbols and line conventions in accordance with either recognised standard, BS or ISO, or as indicated on the drawing legend
- Label the drawing with appropriate pipe, duct and cable sizes where these are not shown elsewhere
- Indicate components which have a sensing and control function and show the links between them, e.g. building management systems, fire alarms and HV controls
- Identify the major components indicated on the schematic drawing so that their whereabouts in specification and on other drawings can be easily determined

Where used as part of the commissioning specification, the drawing should include all data essential to testing and commissioning including volumetric flow rates, design total pressure losses at equipment, locations of dampers, valves and flow measuring stations, electrical fault levels, current ratings, short circuit capacities and tripping times.

d) Detailed Design Drawings

A drawing showing the intended locations of plant items and service routes in such detail as to indicate the design intent. The main features of detailed design drawings should be as follows:

- Plan layouts to a scale of at least 1:100
- Plant areas to a scale of at least 1:50 and accompanied by cross sections
- The drawing shall not indicate the precise position of services, but it should be feasible to install the services within the general routes indicated. It should be possible to produce *co-ordination drawings* or *installation drawings* without major re-routing of the services
- Represent pipework by single line layouts
- Represent ductwork by either double or single line layouts as required to ensure that the routes indicated are feasible
- Symbols and line conventions in accordance with either recognised standard, BS or ISO, or as indicated on the drawing legend

Indicate on the drawing the space available for major service routing in both horizontal and vertical planes.

e) Co-Ordination Drawings

A drawing showing the inter-relationship of two or more engineering services and their relation to the structure and building fabric. The main features of a co-ordination drawing are as follows:

- Plan layouts to a scale of at least 1:50, accompanied by cross-sections to a scale of at least 1:20 for all congested areas
- A spatially co-ordinated drawing, i.e. no physical clashes between the system components when installed at the scaled-off positions shown on the drawing. Provide dimensions in areas where tolerances are minimal

- Make allowance for the service at its widest point for spaces between pipe and duct runs. Allow for insulation, standard fitting dimensions and joint widths on the drawing
- Make allowance for those plant items specified by the designer and identified in the design specification
- Make allowance for installation working space and space to facilitate commissioning and maintenance
- Indicate positions of main fixing points and supports where they have significance to the structural design
- Arrange the services so that it is possible to demonstrate a feasible sequence of installation
- Support the drawing with individual services drawings for clarity
- Plantroom layouts to a scale of at least 1:20, accompanied by cross sections and elevations to a scale of at least 1:20

f) Installation Drawings

A drawing based on the detailed drawing or co-ordination drawing with the primary purpose of defining that information needed by the tradesmen on site to install the works. The main features of installation drawings should be as follows.

- Plan layouts to a scale of at least 1:50, accompanied by cross-sections to a scale of at least 1:20 for all congested areas
- A spatially coordinated drawing, i.e. no physical clashes between the system components when installed at the scaled-off positions shown on the drawing
- Make allowance for inclusion of all supports and fixings necessary to install the works
- Make allowance for the service at its widest point for spaces between pipe and duct runs. Allow for insulation, standard fitting dimensions and joint widths on the drawing
- Make allowance for installation details provided from shop drawings
- Make allowance for installation working space; space to facilitate commissioning and space to allow on-going operation and maintenance in accordance with the relevant health and safety requirements
- Make allowance for plant and equipment including those which are chosen as alternatives to the designer's specified option
- Provide dimensions where the positioning of services is considered to be important enough not to leave to the tradesmen onsite
- Plantroom layouts to a scale of at least 1:20, accompanied by cross sections and elevations to a scale of at least 1:20

g) Installation Wiring Diagram

Drawing showing the interconnection of electric components, panels etc in accordance with the design intent indicated in the schematic drawings and incorporating the details provided on manufacturer's certified drawings. Indicate the following; maximum electrical loading for each supply cable; cable termination facilities; and cable identification and all terminal numbers.

h) Shop Drawings

Drawing prepared by a fabricator or supplier unique to the project. Including supplier's drawings for ductwork, pre-fabricated pipework, sprinkler systems, control and switchgear panels and associated internal wiring.

i) Manufacturers Drawings

Drawing provided by a manufacturer or supplier to indicate a typical representation of the product, components or plant items to be supplied for a particular project.

j) Manufacturers Certified Drawings

Drawing provided by a manufacturer or supplier to indicate details of the product, components or plant items and which the manufacturer or supplier guarantees the supplied equipment shall comply with.

k) Record Drawings

Drawing showing the building and services installations as installed at the date of practical completion. The main features of the record drawings should be as follows:

- Provide a record of the locations of all the systems and components installed including pumps, fans, valves, strainers, terminals, electrical switchgear, distribution and components
- Use a scale not less than that of the installation drawings
- Have marked on the drawings the positions of access points for operating and maintenance purposes
- The drawings should not be dimensioned unless the inclusion of a dimension is considered necessary for location

l) Builders Work Drawings

Design Stage

A drawing to show the provisions required to accommodate the services which significantly affect the design of the building structure, fabric and external works. Also drawings (and schedules) of work to be carried out by building trade, and required to be costed at the design stage eg. plant bases.

Installation Stage

Drawing to show requirements for building works necessary to facilitate the installation of the engineering services (other than where it is appropriate to mark out on site).

m) Controls Logic Diagrams

Diagrams, drawings and/or schematic details of all control components and instruments showing the layout with each item uniquely identified together with a description of the controls operation and details of the associated interlocking.

n) Switchgear, Starter and Control Instrumentation Panel

Drawings showing the construction and internal wiring diagrams of the starters, panels and/or other devices.

o) As-Installed Drawings:

Drawings/records retained on site to record the progress of and any site modifications to the Works; including any changes to software.

2.7 SITE CONDITIONS

The Contractor should visit the site, prior to submitting their tender, to gain knowledge of the accessibility and of the existing site conditions affecting labour, protection of existing services, carriage, unloading and storage of materials, the positions relative thereto of exposed works, buildings, structures, existing underground and above ground services and all other points or matters which can in any way affect the Design & Construction of the Works and the cost of the Contract Works.

Contractors shall satisfy themselves as to the staging, scaffolding, tools, storage, accommodation, etc., required for the proper execution of the Contract.

The Contractor shall also ascertain any such potential future works contemplated currently by the Employer, the Authorities, Companies and organisations and provide within the design of the works such measures as are necessary in these contemplated circumstances. Any dimensions, quantities or any other information given in specifications, or provided otherwise by the Employer are approximate and provisional only, and the onus is upon the Contractor to obtain accurate dimensions and quantities and verify all aspects of the works and site, as he deems necessary. Any monetary or other claim by the Contractor on the ground of want of knowledge or any of the aforesaid matters or things shall not be entertained nor allowed by the Employer and the Contractor accepts all risks in the Contract and interpretation of all information provided by the Employer within these Employers Requirement Documents and in the investigation and interpretation of site and underground conditions at all times.

The Contractor should inspect the drawings, which may be seen by appointment during normal office hours in the office of the Construction Partner.

The Contractor is to set out the works with due consideration for all other trades in accordance with the drawings. Any errors in setting out are to be remedied by the contractor at their own expense. Before the work is put in hand, the setting out is to be approved by the Construction Partner.

All works are to be priced including any item noted on the drawings and not referred to in the Specification or vice versa.

Any claims by the Contractor arising from lack of knowledge of the above mentioned conditions, shall be disallowed and shall not be considered to form a claim when the work is being installed or on completion.

2.8 INFORMATION PROVIDED BY THE EMPLOYER TO SITE AND OTHER CONDITIONS

Any information of whatsoever nature provided by the Employer, including drawings and specification and any in respect of existing services, ground conditions and any other known concealed conditions, structures and the like, is provided absolutely without liability.

The Contractor shall make their own investigations and satisfy himself as to the accuracy of the information provided by the Employer and shall not be entitled to any payment whatsoever or any Extension of Time arising from any conditions eventually discovered, to be in any way different from those indicated in such information, the costs arising from which shall be deemed incorporated within the Contract Sum.

2.9 MATERIALS AND WORKMANSHIP

The whole of the works shall be carried out in a good workmanlike manner and in accordance with recognised trade practices and agreements. All materials shall be, so far as procurable, the best of the respective kinds described in the specification and are to be of the same manufacture for their various types to simplify maintenance and replacements.

All design, materials, workmanship and installation shall be carried out in accordance with the relevant local authority's requirements, Building Control Officer, Fire Officer, British Standards, Codes of Practice, Health Technical Memoranda, Health Building Notes, The IET Wiring Regulations, the recommendations of the CIBSE and SLL guides

The contractor shall ensure that each and every product used on the project meets all the requirements and complies in all respects with the relevant British and European Standards

The contractor shall ensure that every care is taken in installing the various works, materials and equipment included in the Contract. During times of frost or inclement weather, suitable protection shall be provided where necessary, to all items.

The contractor shall, at his own expense, make good any loss or damage occurring to the various works, materials and equipment, included in the Contract before acceptance of the completed works. This shall include not only items to be supplied by the Contractor, but also items handed over to him for installation.

The contractor shall be responsible for keeping his work people under control, including employees of all his contractors, and shall be liable for all damage to the property, adjoining property, grass, vegetation, roads, footpaths, fences and gates, caused by workpeople, lorries or by any other means whatsoever. The contractor's attention is directed to the particular requirements of the Main Contract Preliminaries in these and related matters.

The contractor shall be responsible for storage of all equipment and keeping areas clean and tidy at all times.

The services are to be installed, tested, commissioned and left in full working order to the complete satisfaction of the client and Consulting Engineer.

2.10 DELETERIOUS (PROHIBITED) MATERIALS

The contractor shall not use materials which are deleterious or harmful to human health or the environment during their installation or during long term disposal or degradation. The following substances shall not be specified for use or used in the construction of the works:-

- a) High alumina cement in structural elements
- b) Wood wool slabs in permanent formwork to concrete
- c) Calcium chloride admixtures for use in reinforced concrete
- d) Asbestos or asbestos-containing products, as defined in the Control of Asbestos at Work Regulations, or any statutory modification or re-enactment thereof
- e) Any naturally occurring or man-made mineral fibres (for example, rock-wool or slag-wool) with a thickness of 3 microns or less and a length of 200 microns or less, unless they are appropriately sealed to prevent migration of fibres
- f) Aggregates for use in reinforced concrete which do not comply with BS EN 12620+A1 and/or aggregates for use in concrete which do not comply with BS EN 1992:1+A1
- g) Lead, lead paint or any other materials containing lead which may be ingested, inhaled or absorbed, except where copper alloy fittings also containing lead are specifically required in drinking water pipework by any relevant statutory requirement or where lead flashings or other lead roof coverings are specifically provided for in the contract
- h) Urea formaldehyde foam or materials which may release formaldehyde in quantities which may be hazardous with reference to the limits set by the Health and Safety Executive
- i) Calcium silicate bricks or tiles
- j) Vermiculite unless it is established as being fibre free
- k) Any of the products containing cadmium that are referred to in the Environmental Protection (Controls in Injurious Substances) (No.2) Regulations
- l) Any new timber treated with pentachlorophenol
- m) Tropical hardwoods from a non renewable source
- n) Polyisocyanurate or polyurethane foam
- o) Polyetrafluoroethylene except where used as non stick sealing valves or insulating tape
- p) Glass reinforced concrete
- q) BCF (Halon) fire extinguishing systems
- r) Non-galvanised mild steel structural fixings for building elements particularly susceptible to erosion
- s) Concrete used in circumstances where it is susceptible to alkali/silica reaction
- t) Materials containing chlorofluorocarbons (CFCs)
- u) Solvent based paints except where water based paints are unsuitable or unavailable

- v) Any new materials not in accordance with statutory requirements, British Standards, Codes of Practice and good building practice current at the date of incorporation of the relevant materials into the works the subject of the Development or the specifications therefore
- w) Insulants within the building services installation shall avoid the use of substances with and ozone depleting potential (ODP) in either manufacture or composition
- x) Insulants within the building services installation shall avoid the use of substances with a global warming potential (GWP) of 5 or more in either manufacture or composition
- y) Other materials not in accordance with British Standards and codes of practice

2.11 PROGRAMME

The successful contractor shall submit within fourteen days of acceptance of tender an outline programme of works detailing the intended stages of work and approximate time scales involved. The programme shall also include the 'lead-in period' indicating completion of working/ builderswork drawings and shall include an information required schedule indicating dates when drawings and specifications are required from the Client's team and it shall also indicate key dates for ordering and the deliveries to site of major plant and shall include the number of staff estimated throughout the project.

The programme shall also indicate allowances for drawing submittals by the Contractor to the Client's team. The programme should allow two weeks for the approval period. It is essential that works do not commence without being fully approved by the Consulting Engineer and detailed on working drawings.

Following liaison with the Construction Partner it shall be necessary before starting on site to submit a fully detailed programme and other services. The programme shall be used during the contract to assess progress.

During the course of the contract detailed programmes of work shall be submitted for specific areas (e.g. Testing, Commissioning, Demonstration and User Training) as requested by the Construction Partner.

Due allowance is to be made in the programme for the Works for, but not limited to, the following:

- Ordering and installation periods
- Dates when information is required from others
- The completion of working and builderswork drawings, etc, including the minimum working days for comment
- Work resulting from instructions issued in respect to the expenditure of provisional sums
- Concurrent work by other trades
- Any temporary works necessary for the completion of the engineering services installations
- Pre-commissioning, commissioning and performance testing of the engineering services installations
- Preparation and provision of record drawings and operating and maintenance manuals

Programme information shall be provided as a simple bar chart or critical path network.

The contractor shall provide a separate and detailed commissioning programme for agreement with the Construction Partner. Make due allowance for the following:

- Commissioning, demonstration and instruction procedures
- Provision of written notice before each (or series of) test, inspection, commissioning or demonstration procedures are to be carried out, not less than two weeks
- Demonstration to the Construction Partner that test instruments and equipment are accurate

Due to the potentially disruptive nature of the works, particularly relating to breaking into existing services, the successful Contractor shall be required to provide a detailed schedule and timetable for all break-ins to the existing services, which shall be agreed with the appropriate Client. Upon agreement of the programme, the agreed dates shall be strictly adhered to.

Any variations or modifications to the agreed programme shall be immediately reported to the client for their approval. No changes to the programme or sequence of working shall be carried out unilaterally.

Ensure that procurement details of materials are incorporated in the contract programme.

Avoid delays by submitting details of alternative manufacturers or types of materials/products to the Construction Partner in time to comply with the agreed programme of the Works.

Order all materials/products necessary for the completion of the Works immediately after receipt of comments received and/or instructions to proceed.

No delay to practical completion, or completion of any part thereof caused by delays in ordering shall be accepted.

2.12 PROCUREMENT, PLANT AND MATERIALS

2.12.1 Specialist Contractors

As soon as practicable after entering into the Contract, the Contractor shall enter into such Specialist Contracts required by the Preamble and/or he considers necessary, for the satisfactory completion of the Contract works.

The Construction Partner reserves the right to request that the Contractor shall provide copies of all or any Specialist Contract orders placed by him in connection with this Contract.

2.12.2 Responsibility for Suppliers

The Contractor shall be held responsible to the Employer for ensuring that the performance of all fittings or equipment meet the requirements of this specification, whether or not the manufacturers and suppliers of the fittings or equipment are mentioned in the specification.

The Construction Partner reserves the right to request that the Contractor shall provide a copy of all or any order for items of plant, equipment or materials placed by him in connection with this Contract.

2.12.3 Samples

The Construction Partner reserves the right to request that the Contractor shall provide a sample, properly labeled, of any materials and products proposed for use in the works at no additional cost to the contract.

Such samples shall be submitted to the Construction Partner for their comment at their offices or elsewhere as directed, with all parts left loose, so that they may be taken apart for internal inspection by hand without the necessity of using spanners, screwdrivers or wrenches.

The Construction Partner may require such samples to be subjected to tests designed to ensure compliance with British Standard and other relevant Specifications and requirements of this Preamble.

The Contractor shall provide the facilities and apparatus for such tests and carry them out in the presence of the Construction Partner. The Contractor shall also replace the samples where necessary.

Samples shall be liable to be retained for the purpose of comparison with future deliveries, but any or all of the samples shall be returned to the Contractor should he so request after their purpose has been served.

2.12.4 Site Delivery

The Contractor shall be responsible for the off-loading and storing of their plant and equipment in connection with this Contract.

2.12.5 Name Plates & Labels

All plant and equipment supplied for the works shall give the manufacturer's name, date of manufacture, shop number, type and working conditions, etc., together with all other particulars which shall aid identification for the ordering of spare parts. Any item on which this is omitted shall be rejected.

All items of plant shall be identified by means of a traffolyte label, inscribed with a suitable description of the plant and indicating any applicable references.

All valves throughout the project, with the exception of sanitary ware ball-o-fix valves, shall be fitted with a circular traffolyte label inscribed with its reference number. A typed valve schedule shall be included in the Operating and Maintenance Manual.

All lagged and unlagged pipework shall be identified, at no less than 6m centres, with the appropriate BS colour banding to identify the service. Additional bands shall be fitted adjacent to all valves, and also in all locations where there may be confusion between services.

2.12.6 Handling & Storing Materials & Products

The Contractor shall carry out the following:

- Deliver, off-load, store and transport about the Works all materials and products in the manner recommended by their manufacturers

- Provide adequate safe, covered storage and protection for all new materials and products
- Protect **all** open ends (on equipment, pipework, ductwork, cables, etc) from ingress of dirt dust and moisture by means of purpose made caps or covers
- Provide racks to prevent distortion for storage of conduits, pipes and similar materials
- Store all fittings, accessories and sundry items in clean bins or bagged and stowed in racks and maintained under suitable weatherproof cover
- Where materials and products cannot be stored in dry buildings, they shall be raised clear of the ground and supported. They shall be protected from damage by frost, water and building work with covers or other appropriate means. Materials and products must not be stored by placing directly on earth or any other damp or corrosive surface
- Materials and products shall be adequately coated to prevent damage by oxidation, etc. and this coating shall be maintained until ready for final finishing

2.12.7 Erection of Plant

The erection of all plant and equipment included in the works shall be the sole responsibility of the Contractor, who shall carry out any special instructions given, or recommended, by the manufacturer. In the absence of any instructions, the Contractor shall submit their proposals to the Construction Partner. Should any faulty erection of equipment affect the working efficiency of the plant, the Contractor shall be bound to make good at their own expense.

2.12.8 Quality of Services

All equipment, cabling and accessories provided shall be of excellent quality to prolong their service life and to reduce maintenance costs. All equipment installed shall be capable of being readily serviced, complete with an established local spares network facility.

All services shall be sited and positioned for ease of maintenance procedures. Equipment shall be provided with adequate warning labels and signage to assist in all maintenance procedures.

2.12.9 Standardisation

All materials and items of equipment are to be of the same manufacture for their various types in order to simplify maintenance and replacement.

2.12.10 Plant and System Selection

2.12.10.1 Environmental Aims

The general policy is to provide a building which is environmentally friendly from the global, local external and internal aspects and which minimises the impact on the local community. The building is designed to address the following:

- a) Minimise any negative impact on the local environment and where possible improve it
- b) Minimise the effect of ozone depletion
- c) Minimise the effect on global warming
- d) Minimise air pollution
- e) Minimise water pollution

- f) Minimise rainforest depletion
- g) Minimise non-renewable resource depletion
- h) Avoid radon contamination
- i) Minimise the risk of Legionnaires disease and the spread of Legionella
- j) Minimise the effects of ionising and electromagnetic radiation
- k) Avoid the use of potential irritants and/or toxic substances
- l) Avoid design features associated with Sick Building Syndrome
- m) Maximise the opportunity for recycling
- n) Enable planned preventative maintenance regimes to be used to maintain optimum performance

2.12.10.2 Design Philosophy/Building Life

The building must fully satisfy the requirements of the design criteria while being capable in all respects of providing a working environment which is pleasant, environmentally friendly, energy conserving and maintenance minimised.

Emphasis should be placed, wherever possible, on adopting durable low maintenance materials and avoiding over complicated design resource systems which are expensive to operate and maintain, and costly to replace.

The building should operate effectively and efficiently throughout its design life and materials and components be carefully selected with due consideration to their individual life cycles relative to the overall design life of thirty years required for the building.

In particular, items should not be incorporated which require premature replacement by virtue of their dependence, or relationship to, other elements having a shorter design life.

2.12.10.3 Plant & Equipment Life Factors

The plant and equipment that have been generally selected shall achieve the following plant life factors assuming a good standard of plant maintenance.

All plant and equipment shall be selected to provide an anticipated life to the mid-range of the life factors quoted in CIBSE "Guide to Ownership, Operation and Maintenance of Building Services"

2.12.10.4 Plant and System Sizing

All plant and distribution systems shall be sized in accordance with the recommendations of the CIBSE guides, Institute of Plumbing Guide, IET Wiring Regulations (BS7671) and all relevant British Standards.

The contractor shall clearly indicate in their calculations the publications upon which their design criteria are based.

2.12.10.5 Selection of Manufacturers/Suppliers

Where manufacturers, suppliers or installers of products are not identified by name the contractor shall select products that comply in all respects with the specification and, as and when requested, demonstrate such compliance.

Where manufacturers, suppliers or installers of products are identified by name, or names, but no reference is made to "Or approved" equivalent the contractor shall use only the specified equipment.

Where manufacturers, suppliers or installers of products are identified by name, or names, but reference is made to "Or approved" equivalent the submitted tender must include the named or one of the named suppliers.

Alternatives may be selected and shall be submitted to the Construction Partner for approval, separately.

The contractor shall check that any proposed alternatives comply with any stated British (or other equivalent recognised International) Standards.

The contractor shall confirm equivalence in quality, operation and space requirements to those items which have been specified by name. If, and when requested demonstrate the proposed alternative is fully equivalent to the specified item and identify any constructional, cost, programme, maintenance or other differences.

2.12.10.6 List of Proposed Manufacturers/ Suppliers

A list of proposed manufacturers/supplies of products, equipment and plant, including all items for which the choice of manufacturer/supplier is at the discretion of the contractor, must be submitted within one week of request.

2.12.10.7 Enhanced Capital Allowances (ECA)

All equipment shall be selected to take advantage of the enhanced capital allowance scheme.

The Contractor shall provide the building owner, via the Construction Partner, all necessary information on the installed plant and systems to support a claim under the ECA.

2.12.11 Recommended Spare Parts:

The Contractor shall submit to the Construction Partner not less than 4 weeks before practical completion a schedule of spare parts as called for in individual sections of this specification and any others that the he may recommend should be obtained and kept in stock by the Employer for maintenance of the services installations.

Against each item the manufacturer shall state the current price, including packaging and delivery to site. Those items which are additional to those specified for inclusion in individual Sections should be highlighted.

2.13 DRAWINGS

2.13.1 Tender Drawings

This specification shall be read in conjunction with the Tender Drawings.

The Contract Sum for the Works shall be deemed to also include any item or labour not specifically mentioned herein, but which may be incidental or consequent upon carrying out the whole of the Works described.

The Contractor shall receive and examine all documents issued to him and shall read the documents and drawings issued with the Tender and draw the attention of the Services Consultant to any discrepancies and to anything which in his opinion may be unsuitable, undesirable or inconsistent with his guarantees and responsibilities.

The Contractor shall draw the Services Consultant's attention to any discrepancies in documents, drawings or instructions issued after the time of Tender, immediately upon receipt of same and prior to the commencement of any part of the works affected thereby.

The drawings provided by the Services Consultant are diagrammatic only, in that they are indicative of the general disposition of pipes, ducts, trunking, cables and the like and of the positions of plant. The Contractor shall be deemed to have had regard to the Architect and Structural Consultant's drawings available at the date of his Tender and to have included in his Tender for all necessary ductwork, pipework, cables, conduits and fittings required to overcome and allow for constraints imposed by the design of the structure and any existing structures likely to affect routes or positions.

Where runs of pipework, ductwork, cables, conduits, trays etc. are shown, these do not necessarily indicate exact positions. The Contractor has also to co-ordinate and include for any site visits deemed necessary to satisfactorily complete the Works in accordance with the specification and drawings.

Tender drawings shall not be used for installation purposes. The contractor shall prepare their own working and installation drawings.

2.13.2 Contract Drawings

The Services consultant shall provide 1 printed copy and 1 PDF copy of the Contract drawings showing the general arrangements of the installation.

The Contractor shall satisfy himself as to the accuracy of the information shown on the drawings, and whenever possible, dimensions, levels and positions must be checked on site, for use in the preparation of the installation drawings.

Contract drawings shall not be used for installation purposes. The contractor shall prepare their own working/installation drawings.

2.13.3 Installation Drawings (Working Drawings)

The Contractor shall provide the installation drawings for all services listed in the various sections of this document. Contract or tender drawings shall not be used for installation purposes.

The drawings shall be prepared using the current release of Revit / AutoCAD and the Contractor shall provide 3 paper copies and two electronic copies on CD of each drawing and any subsequent revision.

Installation drawings shall include: -

- a) Risk assessments
- b) General dimensioned layout drawings of the complete works
- c) Detailed layouts showing the location of all plant and equipment including service routes switch rooms and plant rooms
- d) Key area sectional layouts in risers, floor and ceiling voids
- e) Assembly drawings of all factory built equipment and site built assemblies
- f) System diagrams and circuit wiring diagrams for all installations and equipment

The Contractor shall also prepare detailed dimensioned layout drawings showing final connections to equipment.

The Contractor shall ensure that adequate space is provided for servicing and maintenance of all equipment.

If during the progress of the Contract, modifications are required to be made to the work, the Contractor shall submit revised drawings incorporating the modifications.

The Contractor shall be responsible for any discrepancies, errors or omissions in the above mentioned drawings, whether these drawings have been commented on by the Construction Partner or not. Comments given by the Construction Partner to any drawing

shall in no way relieve the Contractor from their liability to complete the works in accordance with the document or exonerate him from any of their guarantee.

2.13.4 Manufacturer's Drawings

The Contractor shall provide to the Construction Partner for comment two copies of any Manufacturers Drawings giving all information, including dimensioned layouts, of all plant and equipment prior to manufacture.

Manufacture of relevant items of plant and equipment shall not commence until the Construction Partner comments on the relevant Manufacturers Drawing has been obtained.

2.13.5 Builderswork Drawings

The Contractor shall provide to the Construction Partner for comment two copies of fully dimensioned drawings to an approved scale, of builders work requirements in connection with this Contract.

Builders work drawings shall be fully dimensioned showing location of holding down bolts, details of anti-vibration mountings and secondary support steelwork, detail of plinths, holes, column bases, tray and trunking supports, all external ducts and duct routes etc. including all statutory authority ductwork and builders work details.

The Contractor shall provide to the Construction Partner full particulars of static and dynamic loading including moments, and dimensions and positions of foundations and plinths, and/or fixings necessary for the support and accommodation of all equipment to be supplied under this Contract, so that adequate provision may be made.

2.13.6 Examination of Drawings/Information

The Construction Partner shall examine the propositions submitted for compliance, in principle, with the design intent. Such an examination shall not relieve the originator of such documents of his responsibilities and obligations under the contract.

2.14 BUILDERSWORK

Holes through walls/floors, chases for cable, pipework and drops shall generally be marked on site. However, if any part of the works requires a more detailed builderswork provision, builderswork drawings shall be issued to the Construction Partner as necessary via their Contractor.

All builderswork shall be submitted to satisfy the Construction Partner programme of works.

Should it not be possible to exactly define a builderswork requirement for any reason within the agreed programme this must clearly be stated to the Consulting Engineer within good time to enable suitable action to be taken.

Should any builderswork requirement not be defined by the Contractor on their drawings or should a detail be incorrectly shown, any alterations that may arise as a result may be subject to a charge by the Construction Partner

2.15 INSTALLATION

2.15.1 Co-Ordination

The Contractor or his appointed representative shall co-ordinate the contract works with the works of all other trades. The Contractor shall include for full liaison with all other Trades, including the all Contractors, with respect to routes and positions of equipment, prior to installation. No additional costs shall be accepted due to abortive work due to non-compliance with this clause.

In positions where other services are to be installed in the vicinity the Contractor shall ensure that the order of installation of the services in relation to each other is coordinated and carefully planned before any installation work commences.

The Contractor shall submit to the Construction Partner dimensioned plan and section coordinated services drawings for known congested areas.

These drawings shall adequately demonstrate that proper co-ordination of the works shall be achieved within the allocated special zones and with the building structure and finishes.

It is the Contractors responsibility to ensure that potential clashes are identified **before** work commences in all areas. The Contractor shall ensure that such co-ordination planning is programmed to provide reasonable time for modifications to be detailed where necessary before installation is due to commence.

The Installation Drawings shall be provided by the Contractor together with site sizes and the necessity of arranging access to all services for maintenance, and to establish the inter-relationship of services in confined spaces. Builderswork drawings shall be provided by the Contractor with full knowledge of the inter-relationship of all services present.

The exact position in the works of the above items relative to grid lines, floors, beams, ceiling, walls and other structural items and any other services in this Contract is the responsibility of the Contractor.

2.15.2 Progress and Monitoring

The contractor shall maintain copy of his programme on site and at weekly intervals update it as a record of progress. The programme shall be updated or redrafted as necessary where circumstances dictate a change which may affect the progress of works.

The Contractor shall keep on site one full set of paper prints of the Installation Drawings marked up to reflect "As Installed" details showing the progress of all work in connection with this Contract.

These drawings, which shall be maintained in clean condition, shall be kept up to date on a weekly basis, and all pipe lines, tray and trunking, positions of equipment and apparatus, including all modifications and/or variations, etc. shall be clearly recorded by the Contractor on the drawings as they are installed.

The contractor shall produce all pipework, ductwork and containment drawings in 'As Fitted' status for inspection prior to ceilings being closed off.

The Contractor shall make the above drawings available at any time for inspection by the Construction Partner.

2.15.3 Attendance

The Contractor shall be responsible for the execution of the following works:-

- a) Supplying all relevant information pertaining to service ducts and chases, etc., in floors, walls and ceilings where necessary
- b) Setting out all holes, ducts, etc., required through walls and any other structures
- c) In addition to (b) above, providing the information regarding the disposition, number and dimensions of all Services on partition walls

2.15.4 Labour & Supervision

The Contractor shall appoint a foreman-in-charge and/or site agent supported by a competent management and supervision team to manage the execution of the contract works.

The Supervisor shall prepare progress schedules and a programme to ensure full exchange of information with other trades and shall be available to attend meetings on site as required.

The Supervisor shall also keep a diary recording the day-to-day progress of the work and the details of all instructions received.

Only skilled tradesmen shall carry out the works, and only one apprentice for every two skilled tradesmen shall be employed on this Contract.

All personnel shall have the appropriate qualifications training and experience to execute their tasks safely and to the highest professional standards.

Each operative level shall be adequately supervised and controlled. The Contractor shall provide a management structure chart showing the key personnel accompanied by a CV for each member.

The Contractor shall observe those conditions of employment which have been agreed between the Employers Federation and the Trades Unions concerned to apply to the place and the circumstances in which these works are to be carried out.

The Contractor shall be responsible for the supervision and correct installation of all work carried out under this Contract whether or not he has, with the permission of the Construction Partner, let any portion of the works as a specialist Contract to this Contract.

Where such a portion of the works has been let to a specialist Sub- Contractor, all contact with him shall be through the Contractor. The Contractor shall ensure that a full time working foreman is employed on the works, to maintain continuity.

At no point during the works shall the foreman be changed without the express consent of the employer or their representative.

2.15.5 Painting & Anti-Corrosion Treatment

All components requiring anti-corrosive treatment shall be painted or shall be treated by other "metal coating" methods.

All welding, drilling, punching, cutting and bending of the metal component shall preferably be done before the protective treatment coating is applied.

All coatings applied shall be entirely suitable for the material to which it is applied and to the conditions to which it shall be subjected to in service.

All components requiring metal protective coatings shall be manufactured from hot-dip zinc coated sheet steel complying with BS EN 10143 and galvanised steel tube and tubing to BS EN 10255. Where galvanising/ sherardizing coatings are specified these shall comply with BS EN ISO 3834 and BS EN ISO 17668 respectively.

All components requiring painting shall be thoroughly cleaned removing all mill scale, weld scale and corrosion and finally degreasing.

All paints shall be lead free type, with primers having good adhesion, good rust covering power, rust inhibiting and grain flowing properties. Gloss paint shall be machine finished paint having high adhesion and high resistance to solvents, mineral oils, cutting oils, detergents, chipping and impact damage.

All paints shall be manufactured by one of the scheduled firms and supplied by one manufacturer, even if the painting is done off site. The paint shall be delivered to site in sealed containers labeled with the following information.

- a) Type of Paint
- b) Brand Name
- c) Manufacturer's batch reference

Work described as painted shall be given one coat of primer and two coats of gloss machine finished paint. Work described as primed shall be given one coat of primer.

Damage to metal coated/painted work shall be repaired to the satisfaction of the Engineer or the component replaced.

2.15.6 Fixing To Building Fabric

The Contractor shall be responsible for the structural integrity of all supports and fixings for plant, equipment and components.

Components and equipment shall be fixed firmly to the building fabric using screws or bolts, as specified, of the maximum size permitted by the fixing holes.

Screw-fixings to solid brickwork or concrete shall be made using substantial proprietary metal or plastic plugs, ensuring that both plug and screw are well embedded into the masonry behind and applied finish. Screw-fixing to sheet metal shall be made using sheet metal screws.

Through-the-wall bolt-fixings shall consist of a bolt sufficiently long to pass through the wall, spreader plate under the head and a nut and washer.

Bolt-fixings to solid brickwork, blockwork or concrete shall be made using self-drilling anchors. Bolt-fixings to hollow backgrounds shall be made using toggle-bolts or expanding plastic rawlnuts.

Bolt-fixings to structural steelwork shall be by means of clamps and adapters of the Lindaptor, installed in the manner recommended by their manufacturer.

The following operations must not be carried out without the permission of the Structural Engineer. Failure to observe this requirement may result in the Contractor having to make good the damage to structural steel, reinforced concrete, facing brick and other materials at their own expense.

- a) Manufacturer's batch reference
- b) Drilling or cutting of holes in structural steelwork
- c) Welding on structural steelwork
- d) Drilling of holes in reinforced concrete
- e) The use of cartridge operated tools
- f) Drilling or fixing to roof purlins

2.15.7 Room Terminal Locations

The positions of all connection points, accessories, apparatus, equipment and other room terminals shown on the tender drawings are approximate and for guidance in the preparation of the tender.

The contractor shall allow for the movement of all such terminals up to a radius of 2.0m from the positions shown on the drawings to account for possible on-site co-ordination.

Mounting heights indicated in tender documents are for tender purposes only. The contractor shall confirm mounting heights before commencing work on site.

The Contractor shall ensure by referring to the Architect's detailed drawings that all accessories are located to suit fitments, benches, etc., and the equipment served by the outlet or accessory.

2.15.8 Positions of electrical outlet points on drawings

Although the position of the electrical outlet points, control switches, and lighting points shall be indicated on the drawings, enquiries shall be made by the electrical contractor to the Consulting Engineer when the work is actually commenced as to the exact position of the various points.

2.15.9 Final Connections

The Contractor shall allow for making all final connections to equipment and for co-ordination with the equipment supplier and manufacturer.

“The use of E.P.D.M lined flexible connections for potable water services installations is strictly prohibited”.

2.15.10 Interruption of Existing Services

The Contractor shall not, unless he has received the written permission of the Construction Partner, interfere with, or interrupt in any way, operation of any existing services such as Gas Mains, Water Mains, Sewers, Drainage, Electricity Cables, etc., and in the case of the work of Statutory Authorities or Private Owners, without also having received permission of such Authorities or Owners.

The Contractor shall be responsible for any damage to such services caused by the Contractor's personnel and equipment and shall make good any such damage at their own expense, to the satisfaction of the Construction Partner, Authorities or Owners.

2.15.11 Connecting To Existing Services

The Contractor shall notify the Construction Partner in writing, giving a minimum of seven days' notice of their intention to connect into or isolate any of the existing services and await their approval for so doing. The notice shall be accompanied by a method statement for the works which includes detailed timings with regard to preparation duration and service interruption.

The Contractor shall include for all overtime and other additional payment necessary to ensure that the interruptions to existing services are carried out with the minimum possible inconvenience. The Contractor shall work without pause until the services are back to a normal situation.

All works shall be carried out under a permit to work system.

2.15.12 Public & Private Services

The Contractor shall be responsible for establishing the condition and capability of all existing services of whatsoever nature and any necessary modifications, diversions, extensions, etc which are necessary for the works, all to be carried out at the Contractors Cost.

The Contractor shall be responsible for and include in the Tender Sum for establishing the condition and capability of all existing gas and water supplies.

2.15.13 Existing Services – Connections and Utilisation in the Project

It is incumbent upon the Contractor to determine the locations, levels, etc or all existing services of whatsoever nature, in preparation of the design of the works and the execution of the works.

The Contractor shall remain solely responsible for all costs of whatsoever nature, arising from any discrepancy in or their failure to determine the locations, levels, etc of existing services and the Contractor shall have no entitlement to claim nor to the payment of any additional monies in respect of any consequences arising from such deficiencies nor shall he be entitled to any Extension of Time arising from any delays or disruption which might consequently arise.

Any particulars provided within the project specifications with regard to existing services are provided for guidance only and their provisions shall not under any circumstances place any responsibility upon the Employer for their accuracy, the entire risk for all works associated with, arising from and in connection with the existing services remaining solely with the contractor.

2.15.14 Notice Prior To Cover

The Contractor shall notify the Construction Partner in writing, giving a minimum of seven day's notice, whenever any works or materials are ready to be covered within building fabric, ceilings, earth or otherwise hidden and shall leave these works uncovered until they have been inspected and approved by the Construction Partner.

Any work which is covered or hidden before inspection by the Construction Partner, shall, where required by the Construction Partner, be uncovered and subsequently made good at the expense of the Contractor.

2.15.15 Protection of the Installation

The Contractor shall allow for taking all necessary precautions to protect the complete installation from any damage which may occur before handover and written acceptance by the Construction Partner.

Ensure all items are protected against ingress of water and dust, formation of condensation, extremes and rapid changes of temperature, building works and operations of others.

The contractor shall provide adequate and safe protection for all materials and products after installation.

Protect all finished items from damage and paint splashes.

Install items such as grilles, diffusers, lighting fittings, switches, accessories etc. as near to completion as practicable.

Only install filter media when the plant items concerned are being commissioned and tested.

Cap all open ends of pipes, ducts, conduit and trunking etc except when being worked upon.

Leave plant and equipment in a ready to paint condition where specified as part of the Works or to be carried out by others.

Paint parts liable to corrosion immediately after removal of any temporary protection.

Replace material, plant or equipment where deterioration or damage has occurred prior to handover. The cost involved in repairing any damage before handover and acceptance shall be borne by the Contractor.

2.15.16 Removal of Rubbish & Cleaning

The Contractor shall at all times keep the site free from obstruction and rubbish insofar as they are a direct result of carrying out the Contract Works and he shall remove from the site at their own expense, all surplus materials and temporary works which were brought on to the site by as soon as these are no longer required. On completion of the works, the Contractor shall leave the site in a clean and tidy condition, to the satisfaction of the Construction Partner.

2.15.17 Notices & Labels

The Contractor shall supply and erect all statutory warning and advisory notices in plant rooms and switchrooms. The notices shall wall mounted in a protective frame.

All plant, equipment, components, isolators and switches shall be fitted with labels detailing their function. The labels shall be black characters engraved on white Traffolyte securely fixed to the equipment.

2.15.18 Materials

All materials and items of equipment are to be of the same manufacture for their various types, in order to standardise and simplify maintenance and replacement.

All materials are to be adequately protected and stored, and the tender price to include for all necessary cabins required for this purpose.

2.15.19 Fire Precautions

The Contractor shall comply with the requirements of the Local Fire Authority, the Licensing Authority, and all documents pertinent to their requirements.

All materials and surfaces incorporated in the construction of the development should have the requisite fire resistance, surface spread of flame and other relevant characteristics appropriate to their location and purpose as specified by the above authorities

2.15.20 Electric Supply

The final electricity supply shall be 400 volts, three phase and 230 volts, single phase, 50 cycles.

The contractor shall be responsible for the provision of all electrical transformers necessary for the completion of their works.

2.15.21 Design Intent

The contractor shall be responsible for ensuring that the Design Intent indicated on the contract drawings is in no way impaired due to additional bends, deviations or changes in the service routes and plant layout.

2.15.22 Access to Plant

Plant arrangement shall be installed in such a manner that components may be installed, accessed, maintained, removed and replaced without difficulty and without compromising the safety of personnel. The installation shall, as a minimum, satisfy the following requirements:-

- a) BS:7671 Requirements for Electrical Equipment of Buildings
- b) Manufacturers recommendations
- c) BS: 8313 (Accommodation of Building Services in Ducts)
- d) BSRIA Application Guides - Design for Maintainability
- e) BSRIA Technical Notes - Space Requirements for Building Services Distribution Systems
- f) Construction (Design & Management) Regulations
- g) HTM 2033 – 2 Access and Accommodation for Engineering Services

All maintainable items of plant shall be accessible from floor level or via permanent access walkways.

All items of plant which are likely to be replaced within the life of the building shall be arranged such that they can be removed without dismantling any elements of permanent structure and without comprising normal access and escape routes. For the purposes of

this requirement permanent structure shall be defined as any building components which cannot be removed or reassembled within a time limit of two hours.

The above requirements are intended to indicate the expected standards.

Should it prove necessary to compromise any access provision the Contractor shall the record proposals and justification and shall submit to the Construction Partner and the CDM Coordinator / Principle Designer. If accepted as the most appropriate arrangement details of the non-compliance shall be recorded in the Operating and Maintenance manuals and the Health and Safety file.

2.15.23 Acoustic Control of Plant

The Contractor shall ensure that all plant, equipment and components provided meet the appropriate internal and external acoustic criteria for the development.

The Contractor shall assess the impact of each item upon internal and external noise levels and provide the acoustic treatment necessary to meet the requirements.

The Contractor shall submit details of these assessments and acoustic treatment to the Construction Partner before equipment is ordered.

2.15.24 Electromagnetic Compatibility

The contractor shall ensure all equipment and systems are installed to provide electromagnetic compatibility within the system and with any other systems installed in the same area. Ensure all systems and buildings are assessed for protection to, and that such protection meets the requirements of BS EN 62305 Part 1. Ensure all equipment meets the requirements of the appropriate electromagnetic compatibility standard.

2.15.25 Software

The contractor shall obtain on behalf of the end user all appropriate licenses', permissions, copyright waivers, rights of use and the like from the owners of the software rights.

Ensure that the end user is properly registered with the software supplier for support and appropriate updating.

Ensure that application software is written in compliance with the appropriate British and European Standards

2.15.26 Rotating Plant

Immediately prior to Practical Completion the contractor shall adjust, ease and lubricate moving parts as necessary to ensure easy and efficient operation.

2.15.27 Testing and Commissioning of Services

The testing and commissioning of the system shall be carried out fully in accordance with the details as contained in the specification and full cost allowances shall be included in this respect.

The contractor shall review all designs to ensure that systems are commissionable and highlight for review by the Construction Partner any considerations in respect of commissioning. Provide a report signed, by a competent person confirming, prior to installation that all system designs can be commissioned.

Ensure that the commissioning requirements are compatible with any project restraints concerning sectional handover/ phasing.

Agree with the Construction Partner a programme for pre-commissioning checks, setting to work, commissioning and performance testing, and allow for all costs incurred.

Give not less than 10 working days' notice to the Construction Partner and/or employer of any testing or commissioning works and state any requirements for the attendance and co-operation of others.

Maintain on site full records of all commissioning and performance testing, cross referenced to system components and on completion of the Works include a copy in each Operating and Maintenance Manual.

Prepare comprehensive commissioning method statements including procedures, logic diagrams and risk assessments for:

- Pre-commissioning checks
- Flushing and chemical cleaning
- Setting to work
- Commissioning and testing
- System proving

The contractor shall prepare a set of drawings and/or report sheets to record accurately the test and inspection information including the following.

- Plant identification, section and installation under test
- Manufacturer's reference number
- Date, time, duration of test, weather conditions
- Test results with itemised readings including records of all other checks and tests

Maintain records of all specified inspections and tests performed including third party and works test certificates.

Include in records, as appropriate, details of the element, item, batch or lot, the nature, number and date of the inspections and tests, the number and type of deficiencies found, any corrective action taken and other relevant particulars.

Maintain all records on site for inspection. On completion of the Works, include copies in the operating and maintenance manuals.

Submit copies of records within one week of request.

Test all equipment, material and systems as detailed in the particular specification. If an inspection or test fails, repeat the procedure, until satisfactory results are obtained.

The Construction Partner shall only witness test proceedings, confirm recorded results and determine if the specified requirements have been satisfied. If following test or inspection any plant or part thereof is shown to be defective or not conforming to the specification the

Construction Partner shall reject such defective parts by written notice, within reasonable time, indicating area of dispute.

All tests shall be completed before any paint, cladding or similar materials are applied or before services are concealed.

Following satisfactory completion of testing and when the installations are in a safe and satisfactory condition, set to work, regulate and adjust, as necessary, to meet the specified design requirements.

Provide all necessary instruments and recorders to monitor systems during commissioning and performance testing.

The contractor shall provide all necessary attendance for commissioning works carried out by specialist contractors and equipment manufacturers.

Provide all necessary facilities to enable tests to be witnessed and inspections carried out including all necessary instruments and recorders to monitor systems during the commissioning and environmental proving period.

Ensure all certification is attained and witnessed as necessary for inclusion in the record documentation.

Provide all certification documents for approval by the Construction Partner before any system is offered for final acceptance.

Provide a final commissioning report, signed by a competent person, detailing the results of the commissioning and commenting on the performance of systems. The report to confirm that each installation is correctly tested and commissioned, achieves the specified performance and in accordance with CIBSE Code M.

All gas, fuel oil, electricity and water for testing and commissioning shall be provided by the contractor unless alternative arrangements made with the client.

On completion of all works covered by the contract, the contractor shall ensure that all such work including all equipment is left in a clean and tidy state. They shall also be responsible for ensuring that all packing materials, empty cartons, unusable equipment and all waste materials are removed from the site.

2.16 SUPPLY CONNECTIONS AND LOCAL AUTHORITIES

The contractor shall carry out load assessments based upon the initial concept proposals and liaise directly with the statutory authorities in order to obtain quotations for the gas, water, electrical and BT.

The Contractor shall include for liaison with the utility service providers for electricity, gas, water, drainage and telecoms regarding the provision of service connections and associated ducting and builders work.

The contractor is responsible for organizing the necessary witness testing and installation programme dates with the statutory authorities including Building Control, the Water Supply Authority and Environmental health.

In addition to the above, the contractor shall be responsible for any diversions / disconnection required and shall liaise directly with the statutory authorities to successfully complete the works.

Upon completion of the works the Contractor shall demonstrate the systems to the utility representatives and make any modifications or alterations requested.

2.17 PRACTICAL COMPLETION OF WORKS

A certificate of Practical Completion shall not be issued until the contractor has completed the installation works to the satisfaction of the Construction Partner.

The Contractor shall record readings of all water, gas, and electricity meters immediately on completion of the Works and forward, via the Construction Partner, to the Construction Partner.

This shall include:

- All engineering installations have been completed and snagging items attended to
- Commissioning and testing reports have been provided
- Record Drawings, Operating and Maintenance (O&M) Manuals and Building Log Books have been completed and issued
- Employers staff have been instructed in the correct operation of the installation

2.17.1 Systems Used Before Practical Completion

Systems may not, without the prior written approval of the Construction Partner be used before Practical Completion. Systems to be used before practical completion for the benefit of the Contractor and/or Subcontractor must have all defective consumable elements (including lamps and tubes) replaced by new not more than seven days prior to Practical Completion. No system shall be put into use prior to handover to the employer, except for testing and commissioning, unless in accordance with the following procedure:

Following the receipt of written instructions, the contractor shall operate designated parts of the Contract Works, provided that such operation is practicable and does not prejudice the contractor's responsibilities and obligations under the contract.

Additionally and with adjustment to the contract sum, the contractor, shall if instructed, provide:

- Comprehensive insurance including indirect loss for any plant being operated
- Maintenance of the installation
- Re-instatement of the installation to as new condition prior to handover to the Employer
- Allow the defects liability period to commence on handover

2.17.2 Training of Employer's Staff

The Contractor shall allow for providing demonstration of the purpose, function and operation of the installations including all items and procedures listed in the Operation and Maintenance Manual to not less than 4 of the Employers maintenance and/or operational staff before practical completion.

This shall include training in the use of the controls or BMS installations installed or modified as part of the works.

The contractor shall fully maintain all existing services to existing premises during the progress of the Works.

Provide any additional work and materials necessary to maintain these services at all times during the duration of the Contract. Any existing services disturbed by the Works are to be reinstated fully in accordance with the standards of quality defined in the specification and to the satisfaction of the Construction Partner.

Unless otherwise agreed with the Construction Partner, all connections to existing services shall be made out of normal working hours.

2.17.3 Proposals for Annual Maintenance Contract

The contractor shall submit before completion (but not less than 4 weeks prior) of the contract a supplementary proposal for an annual maintenance contract for the installations undertaken.

The proposal should include for maintaining the installation in efficient working order including routine checks, adjustments, lubrication and replacement of consumable spares, etc.

It should set out the terms of the offer, the work to be carried out, the guarantees of performance and the price of the first 12 months after Practical Completion of the Works or Section thereof.

The proposal shall not necessarily be considered as part of the tender for the Subcontract Works and the Employer does not undertake to accept it.

2.18 12 MONTHS DEFECTS LIABILITY PERIOD

The Contractor shall include for a 12 months liability period commencing from the handover date of the installation. The contractor shall ensure that, where necessary, all plant and equipment have extended warranties to meet this contract condition.

Immediately the contractor effectively completes the installation, or any agreed section of the installation which shall be immediately prior to the Construction Partner handover, he shall advise the Consulting Engineer, in writing, to this effect and provide a list of outstanding matters.

The Consulting Engineer shall then make a thorough examination of the installation and shall prepare a defects list which shall be issued to the Contractor.

Immediately upon receipt of this document it would be in the interest of the Contractor to complete and correct all items as listed within two weeks.

This shall include making good all defects due to the incorrect or poor installation of services provided. It shall not include for the wear and tear to the system by the users.

Failing which the Employer shall execute the necessary repairs, including the supply of materials and labour and the account of the Contractor shall be debited, via the Construction Partner with the cost incurred in the execution of such repairs, the obtaining of the materials and labour, and all establishments and other charges in connection therewith. The contractor is to clearly state within the Operating and Maintenance manual the name, address and telephone number of persons to contact in the event of emergency and failure.

The sub-contractor is to allow within his tender the cost of a return visit to site within one month of handover to check that all systems are operating satisfactorily. Should defects be apparent the contractor is to make the necessary arrangements for these to be rectified.

The contractor is to include within the tender a return visit to site at the end of the defects liability period, to carry out a thorough check of all components and aspects of the system to ensure that everything is operating satisfactorily.

All requests for remedial action to the installation shall be quickly responded to (within 48 hours of being notified) and shall include all labour and replacement equipment as required.

2.18.1 Obligations during Defects Liability Period

The contractor shall:

Prepare and submit records of failures or malfunctions of any part of the Contract Works during the Defects Liability Period, together with details of remedial action taken, subsequent re-testing and the results.

Notify the Construction Partner of damage, failures or malfunctions to the Contract Works demonstrably caused by incorrect operation of the installations, vandalism or other actions by a third party.

Inform the Construction Partner in writing when all defects are finally rectified so that an inspection may be carried out prior to the issue of a Final Certificate.

2.19 OVERTIME

Unless otherwise stated, the contractor shall assume that the work may proceed during normal working hours and shall liaise with the Construction Partner to establish the duration of normal working hours. The excess cost of overtime or night work shall only be paid for as an extra if it is worked on the written instructions of the Architect.

The contractor SHALL HOWEVER INCLUDE OVERTIME COSTS for ALL break-in's to existing installations

Time sheets in respect of overtime and/or night work ordered by the Architect/Contract Administrator shall be submitted weekly to the Architect/Contract Administrator and shall be properly filled in showing the names of the work people concerned, the hours worked and the rates of pay.

Should, however, the contractor wish to work overtime **at his/her own expense** to facilitate the progress of the contract works, the sanction of the Construction Partner must be obtained before the overtime is worked.

2.20 TEMPORARY POWER, LIGHTING AND WELFARE

All temporary power and lighting within the building and welfare facilities shall be provided by the Construction Partner. The Contractor should advise in his tender for any specific abnormal requirements, e.g. temporary 3 phase power supply.

2.21 VARIATIONS

No variations or additions to the contract are to be undertaken without the prior written approval of the Construction partner.

Where possible, estimates are to be agreed prior to the work being commenced and are to be priced on the Schedule of Rates, which form part of the contract. The contractor shall submit to the Construction partner, within seven days of receipt of the written instruction, the price for each variation showing quantities and rates applicable for all labour and materials employed in accordance with the schedule of rates.

No works shall be certified for payment until this information has been provided.

Where work cannot properly be measured and valued, the Contractor shall allow Day Work Rates. Where such work is authorised, record sheets detailing all labour and materials employed are to be recorded daily and signed weekly by the Clerk of Works, and triplicate copies forwarded to the Construction partner Offices, immediately after signing.

No payment shall be permitted unless the above conditions are strictly complied with.

2.22 VALUE ADDED TAX

The tender sum must be quoted, and subsequently the contract sum shall be exclusive of Value Added Tax.

Upon being informed that his tender is being recommended for acceptance, the contractor shall give to the Construction Partner a provisional assessment of that part of the value of the goods and services supplied under the sub-contract for which the sub-contractor shall be liable at a positive rate of VAT (and for which VAT the Client shall be called upon to pay under the VAT agreement) and that part for which he shall be liable at zero rate, and shall also state the grounds on which he considers any supply of goods and services to be positively rated. Such provisional indication shall not be binding on either party.

2.23 PROVISION OF RECORD DOCUMENTS

2.23.1 General

To satisfy the provisions of the Health and Safety at Work Act the Employer shall not accept handover of the installations until full and adequate information concerning the installations is in the possession of his operating and maintenance staff.

The Contractor shall supply to the Construction Partner, as a pre-requisite to Practical Completion, comprehensive record documents in uniform indexed bound sets. The Contractor is advised that great importance shall be placed upon the quality, accuracy, clarity and completeness of the record documents and upon their prompt availability.

The Contractor shall demonstrate from time to time, as required by the Construction Partner throughout the execution of the Works, that adequate and accurate records are being kept such as shall ensure the ultimate completeness and accuracy of the record documents and that the record documents are themselves being progressively compiled as the work on site proceeds.

Draft copies of all record drawings and O&M manuals shall be issued to the Construction Partner for comment a minimum of 4 weeks prior to practical completion.

Record documents shall comprise the following:

- a) Record Drawings and Schedules
- b) Operating and Maintenance Instructions

All record documents shall be provided in **triplicate** and be adequate for the following purposes: -

- a) to provide a comprehensive reference source about each installation
- b) to provide a basis for the correct and efficient operation of the installed plant and system
- c) to serve as an information base and detailed guide for the effective and efficient maintenance of each installation
- d) to serve as a basis for staff training in the operation and maintenance of each installation
- e) to serve as a basis for safety awareness

The record documents shall be correlated so that the terminology and the numerical and/or other references used are consistent with and similar to those used in the physical identification of component parts of the Works.

The contractor shall allow for obtaining and collating all necessary information to allow the preparation of the manual, including any charges that may be required by manufacturers or suppliers for the provision of literature and information.

Unless otherwise indicated, all drawings and manuals shall be supplied in both paper (hard copy) and electronic format.

If the Contractor fails to comply with these requirements, a specialist contractor may be instructed to be prepared the records and the whole of the costs involved in this, including all costs of surveying, printing etc, shall be borne by the Contractor.

2.23.2 Operating & Maintenance Instructions

Operating and Maintenance Instructions shall be provided by the Contractor and shall comprise the following as applicable (all contained in volumes strongly bound in flexible covers and suitable for heavy usage over a long period and electronic CD/memory stick copies also) written to be read in conjunction with the Record Drawings, Diagrams and Schedules:

- a) A full description of each of the systems installed, written to ensure that the Employer's staff fully understand the scope and facilities provided
- b) A description of the mode of operation of all systems including services capacity and restrictions
- c) Diagrammatic drawings of each system indicating principal items of plant, equipment, valves etc
- d) Details of how to re-commission so that complex plant services within the building can be re-commissioned by an engineer without any historic knowledge of the systems
- e) A photo-reduction of all record drawings together with an index. Reduced size of drawings to be A3
- f) Legend of all colour-coded services
- g) Schedules (system by system) of plant, equipment, valves, etc., stating their locations, duties and performance figures. Each item must have a unique number cross-referenced to the record and diagrammatic drawings and schedules
- h) The name, address and telephone number of the manufacturer of every item of plant and equipment together with catalogue list numbers
- i) Manufacturer's technical literature for all items of plant and equipment, assembled specifically for the project, excluding irrelevant matter and including detailed drawings, electrical circuit details and operating and maintenance instructions
- j) A copy of all Test Certificates, Inspection and Test Records, Commissioning and Performance Test Records (including, but not limited to, electrical circuit tests, corrosion tests, type tests, start and commissioning tests) for the installations and plant, equipment, valves, etc., used in the installations. records shall be clearly cross referenced to system components
- k) A copy of all manufacturers' guarantees or warranties, together with maintenance agreements offered by sub-contractors and manufacturers
- l) Copies of Insurance & Inspecting Authority Certificates and Reports
- m) Starting up, operating and shutting down instructions for all equipment and systems installed
- n) Control sequences for all systems installed.
- o) Schedules of all fixed and variable equipment settings established during commissioning
- p) Data on general design parameters and associated normal operating values, based on the commissioning activity
- q) Procedures for seasonal change-overs and/or precautions necessary for the care of apparatus subject to seasonal disuse
- r) Detailed recommendations for the preventative maintenance frequency and procedures which should be adopted by the Employer to ensure the most efficient

operation of the systems. This information may be supported in detail, but not replaced by, maintenance instructions provided by the suppliers or particular component apparatus

- s) Details of lubrication systems and lubrication schedules for all lubricated items
 - t) Details of regular tests to be carried out (e.g. water cooling towers, water analysis for pseudomonas etc)
 - u) Instructions in respect of any precautionary measures from time to time necessary (e.g. against bacterial contamination, corrosion or freezing)
 - v) Details of procedures to maintain plant in safe working conditions
 - w) Details of the disposal requirements for all items in the works
 - x) A list of normal consumable items
 - y) A list of recommended spares to be kept in stock by the Employer, being those items subject to wear or deterioration and which may involve the Employer in extended deliveries when replacements are required at some future date
 - z) A list of any special tools needed for maintenance cross referenced to the particular item for which required
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- aa) Procedures for fault finding
 - bb) Clear and comprehensive instructions for the starting up, running and shut down of each system or apparatus
 - cc) Clear and comprehensive instructions for dealing with emergency conditions for each system or apparatus
 - dd) Two back-up copies of any system software, as commission.
 - ee) Details of the software revision for all programmes provided.
 - ff) Documentation of the procedures for updating and/or modifying software operating systems and control programmes
 - gg) Instructions for the creation of control procedure routines and graphic diagrams
 - hh) Copies of relevant HSE/CIBSE/IET Guidance notes etc
 - ii) Contractual and legal information including but not limited to details of local and public authority consents; details of design team, consultants, installation contractors and associated subcontractors; start date for installation, date of practical completion and expiry date for the defects liability period; details of warranties for plant and systems including expiry dates, addresses and telephone numbers
 - jj) Data on general design parameters and associated normal operating values, based on the commissioning activity

In addition, the following information shall be provided in respect of the controls and BMS installations.

- a) A written description of plant operation
- b) Control strategy/logic diagrams recording the final version of configuration software installed at handover
- c) Details of system application software configuration
- d) A points list including hard and soft-points (all points should have a unique mnemonic)
- e) A description of user adjustable points
- f) Commissioning record details
- g) Detailed data sheets for all control components and equipment

- h) Wiring circuit details including origin, route and destination of each cable
- i) Basic security access to the system
- j) Comprehensive instructions for switching on, operation, switching off, isolation, fault finding and procedures for dealing with emergency conditions
- k) Instructions for any precautionary measures necessary
- l) Instructions for the routine operation of the control system including simple day-to-day guidance for those operating the control system with limited technical skill
- m) Instructions for servicing and system upkeep
- n) A provision for update and modification
- o) For each programmable control item, schedules indicating for each input and output point Connected, full data in respect of that point including reference, type of input/output, connected equipment reference, set values of temperature or pressure etc., set values of start/stop/speed change times, alarm priority, control specification reference and any other such parameters as are applicable
- p) Each spare input and output point including reference, type of input/output and space for future entry of appropriate parameters as listed above
- q) Logic flow diagrams for each individual control or monitoring specification and for each building services engineering system to illustrate the logical basis of the software design
- r) Schedules setting out details of all initial values of user-defined variables, text statements for alarm messages etc. Copies of manufacturer's data shall be supplied with respect to the nature, type and method of operation of individual pieces of equipment, together with their detailed maintenance instructions. Such data, in the form of individual booklets and the like, shall be indexed and cross referenced to the Operating and Maintenance Instructions and presented suitably protected in box files or folders

The covers shall be printed with a specific fascia clearly indicating the names of the Project and Client and shall be to the approval of the Construction Partner.

Any record drawings to be inserted within the manuals shall be contained within individual plastic insert envelopes and folded to display title and drawing number clearly when in envelope. A further set of record drawings, reduced to A3 size shall also be included in the manual.

Any manufacturer's information sheets to be included within the manuals shall be contained within individual plastic insert envelopes and folded to display title and page number clearly when in envelope. A front index sheet shall also be included at the front of each of these sections to list the page numbers of the manufacturer's information sheets.

Each section of the manual shall be divided by a stiff divider of the same size as the folder. The divider shall be labeled as to the section of the manual which follows it.

All written instructions within the manual shall be typewritten.

Approved final copies of the O&M manuals are provided at handover. The O&M manual shall be properly indexed and all terminology and references shall be consistent with the physical identification of component parts.

2.23.3 Record Drawings

Record drawings shall be provided by the contractor for all works carried out under the contract. Record drawings shall include, but not be limited to, the following:

- a) The location of statutory service connections provided within the contract, whether installed by the contractor or the statutory authority, including buried depth, point of origin and termination, size and materials of pipelines, flowrates, pressures and all other relevant information
- b) The layout, location and depth of all underground services
- c) The layout, location and extent of all piped services, including pipe sizes and position of all valves, drain cocks, test points, gauges and all other instrumentation and fittings. All emitters shall be clearly referenced and their outputs identified
- d) The layout, location and extent of all air ducts, including builders work ducts, showing balancing dampers, fire dampers, silencers, grilles, diffusers, louvres, access panels, turning vanes, test points, gauges and instruments and all other associated fittings. Each duct and terminal should be marked with its dimensions and flowrate. All terminal devices shall be clearly referenced
- e) The layout, location and extent of all electrical services, including distribution boards, lighting, emergency lighting, small power, fire alarm intruder detection and all other specialist installations
- f) Detailed general arrangements of all plant rooms, tank rooms electrical switch rooms and other plant and apparatus, including the location, identity manufacturer, size and rating of each apparatus
- g) Control and wiring diagrams shall be provided incorporating details of each instrument and equipment item and a written description of the sequence of operation
- h) Location identity, size and details of all apparatus and control equipment served by, or associated with, each of the various services
- i) Schematic drawings of each system indicating principal items of plant, equipment, zoning, means of isolation, etc. in sufficient detail to make it possible to comprehend the system operation and the inter-connections between various systems
- j) Location and identity of each room or space housing plant, machinery or apparatus
- k) Details of co-ordination of wiring and connections with cable core identification, notation of fire alarm, security, control and instrumentation and similar systems provided as part of the Works
- l) Details to show inter-connections between the Works and equipment or systems provided by others to which wiring and connections are carried out as part of the Works
- m) All cable/conduit routes shall indicate if the service is surface mounted, concealed in wall chase, in floor screed, cast in-situ, above false ceiling etc
- n) Manufacturers' drawings of equipment indicating:
 - General arrangement and assembly of component parts which may require servicing
 - Internal wiring diagrams together with sufficient physical arrangement details to locate and identify component parts
- o) Schedules as required to locate, reference and provide details of ratings and duty of all items incorporated into the Works together with all fixed and variable equipment settings established during commissioning
- p) All record drawings shall be clearly marked "RECORD DRAWING" in 19mm text. In addition each record drawing shall show the following information:
 - The project title and, where appropriate, the zone or floor reference
 - Description of drawing, drawing number, scale and size

- Name and address of the contractor and consulting engineer

Plans and sections of all plant areas, equipment rooms, service subways, trenches, ducts and other congested areas shall be to a scale of not less than 1:20.

Floor layouts shall be to a scale of not less than 1:50.

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

Electrical drawings shall be in accordance with IET Wiring Regulations and with the specific requirements of the project specification.

The completed record drawings and schedules shall be submitted for comment with the operating and maintenance manuals.

Three complete sets of all record drawings in AutoCAD(or later) / Revit (BIM)format on CD, and three sets of paper prints shall be available at the contract completion date for handover to the employer.

2.23.4 Plant Room and Switch Room Record Drawings, Schedules and Schematics

In addition to Record Drawings, the contractor shall provide schedules and schematic drawings mounted within each plant room and switch room, any other appropriate location where directed by the Construction Partner.

These shall include, but shall not be limited to, the following:

- a) Location of mechanical and electrical plant and equipment items
- b) Schematic drawings of circuit layouts showing identification and duties of equipment, numbers and locations, controls and circuits
- c) Valve schedules in the form of printed sheets showing the number, type, location, application/service and symbol, and normal operating position of each means of isolation, control schematics
- d) Location of all plant and equipment items including plans and elevations of main switchgear showing physical disposition of switches
- e) First aid instructions for treatment of persons after electrical shock
- f) All other items required under Statutory or other regulations
- g) Location of all incoming services isolation valves/switches and metering facilities
- h) Emergency operating procedures and telephone numbers for emergency call out service applicable to any system or item of plant and equipment
- i) All other items required under statutory or other regulations

All drawings and schedules shall be framed under glass or other rigid, transparent, cleanable and protective surface.

2.23.5 Electronic Operating and Maintenance Manuals

Three copies of all operating and maintenance manuals shall be provided on CD in PDF format. The documentation shall be as provided in hard copy format and shall include all data sheets, testing and commissioning results, manufacturers literature, wiring diagrams and record drawings.

The electronic manuals shall be logically laid out, reflecting the format of the hard copy manuals.

2.23.6 Building Log Book

In addition to the O&M Manual provided above the sub-contractor shall also provide a log book which is to be handed over to the building owner and/or occupier. The log book shall give details of the installed building services plant and controls, their method of operation and maintenance, and other details that collectively enable energy consumption to be monitored and controlled. The information should be provided in summary form, suitable for day to day use and in easy to read user friendly text for non technical personnel. This summary could draw on or refer to information available as part of the Operation and Maintenance Manuals and the Health and Safety file.

The details to be provided should include:

- a) A description of the whole building, its intended use and design philosophy and the intended purpose of the individual building services systems
- a) A schedule of the floor areas of each of the building zones categorised by environmental servicing type (e.g. air-conditioned, naturally ventilated)
- b) The location of the relevant plant and equipment, including simplified schematic diagrams
- c) The installed capacities (input power and output rating) of the services plant
- d) Simple descriptions of the operational and control strategies of the energy consuming services in the building
- e) A copy of the report confirming that the building services equipment has been satisfactorily commissioned
- f) Operating and maintenance instructions that include provisions enabling the specified performance to be sustained during occupation
- g) A schedule of the building's energy supply meters and sub-meters, indicating for each meter, the fuel type, its location, identification and description, and instructions on their use. The instructions should indicate how the energy performance of the building (or each separate tenancy in the building where appropriate) can be calculated from the individual metered energy readings to facilitate comparison with published benchmarks
- h) The measured air permeability of the building

The above is a generalized list and the contractor shall provide all information necessary to comply with the Building Regulations Part L.

Notwithstanding the above, the Tenderer shall ensure that the format follows that adopted by CIBSE TM31 'Building Log Book Template'.

2.24 BUILDING USER GUIDE

To assist in achieving the required BREEAM rating (if applicable) the contractor shall assist the Construction Partner to compile a simple user guide that covers information relevant to the tenant / occupants and non technical building manager on the operation and environmental performance of the building. The sub-contractor shall be expected to assist the Construction Partner by contributing to the building services aspects of the user guide and provide the relevant information required for inclusion.

A description of the whole user guide is provided below and the sub-contractor shall provide the Construction Partner with the required information, where relevant. This requirement is in addition to the requirement to provide O&M Manuals and the Building Log Book.

User Guide Contents

The list below indicates the type of information that should be included to meet the needs of the Facilities Management (FM) Team/Building Manager and the general users (staff).

1. Building Services Information
 - **General User** – Information on heating, cooling and ventilation in the building and how these can be adjusted, e.g. thermostat location and use, implications of covering heating outlets with files, bags, etc. and use of lifts and security systems
 - **FM** – As above plus, a non technical summary of the operation and maintenance of the building systems (including BMS if installed) and an overview of controls
2. Emergency Information
 - **General user** – Include information on the location of fire exits, muster points, alarm systems and fire fighting systems
 - **FM** – As above plus, details of location and nature of emergency and fire fighting systems, nearest emergency services, location of first aid equipment
3. Energy & Environmental Strategy

This should give owners and occupiers information on energy efficient features and strategies relating to the building and also provide an overview of the reasons for their use, e.g. economic and environmental savings. Information could include:

 - **General User** – Information on the operation of innovative features such as automatic blinds, lighting systems etc, and guidance on the impacts of strategies covering window opening and the use of blinds, lighting and heating controls
 - **FM** – As above plus, information on airtightness and solar gain (e.g. the impact of leaving windows/doors open in an air conditioned office, or use of blinds in winter with respect to solar gain); energy targets and benchmarks for the building type, information on monitoring such as the metering and sub metering strategy and how to read, record and present meter readings
4. Water Use
 - **General User** – Details of water saving features and their use and benefits, e.g. aerating taps, low flush toilets, leak detection, metering etc
 - **FM** – As above plus, details of main components (including controls) and operation. Recommendations for system maintenance and its importance, e.g. risk of legionella
5. Transport Facilities

- **General User** – Details of car parking and cycling provision; local public transport information, maps and timetables; information on alternative methods of transport to the workplace, e.g. car sharing schemes; local 'green' transport facilities
- **FM** – As above plus, information on conditions of access, maintenance and appropriate use of car parking and cycling facilities, e.g. number of spaces provided

The above information does not need to be included in the user's guide if there is a separate dedicated travel information space, accessible to the staff, and in compliance with BREEAM credit T10. However the guide must reference the travel information space, the information provided and its location.

6. Materials and Waste Policy

- **General User** – Information on the location of recyclable materials storage areas and how to use them appropriately
- **FM** – As above plus, information on recycling, including recyclable building/office/fit out components, waste storage and disposal requirements; examples of Waste Management Strategies and any cleaning maintenance requirements for particular materials and finishes

7. Re-fit/Re-arrangement Considerations

- **General User** – An explanation of the impact of repositioning of furniture, i.e. may cover grilles/outlets, implications of layout change, e.g. installation of screens
- **FM** – As above plus, environmental recommendations for consideration in any refit. Relevant issues covered in BREEAM should be highlighted, e.g. the use of natural ventilation, use of Green Guide 'A' rated materials, re-use of other materials etc., the potential impact of increasing occupancy and any provision made in the original design to accommodate future changes

8. Reporting Provision

- **General User** – Contact details of FM/manager, maintenance team, and/or help desk facility; and details of any building user group if relevant
- **FM** – As above plus, contact details of suppliers/installers of equipment and services and their areas of responsibility for reporting any subsequent problems

9. Training

Details of the proposed content and suggested suppliers of any training and/or demonstrations in the use of the building's services, features and facilities that shall be needed. This could include:

- **General User** – Training in the use of any innovative/energy saving features
- **FM** – As above plus, training in emergency procedures and setting up, adjusting, and fine tuning, the systems in the building

10. Links and References

This should include links to other information including websites, publications and organisations. In particular, the 'Carbon Trust' programme should be referenced and links provided to its website and good practice guidance.

11. General

Where further technical detail may be required by the FM Team or Manager there should be references to the appropriate sections in the Operation and Maintenance Manual.

2.25 PATENT

The Contractor shall indemnify the Employer against all claims, cost or expense in connection with any patented, copy-righted or protected article supplied by the Contractor or their Specialist Sub-Contractor and used on or in connection with the works and any payments or royalties payable in one sum or by installments shall be included in the Contract price and paid by the Contractor to whosoever they may be due.

In the event of any such claims being made on the Employer, in connection with such patented articles, he shall immediately notify the Contractor who shall, at their own expense, conduct any negotiations or litigation in connection with such claims.

SECTION THREE – MECHANICAL STANDARD SPECIFICATION

3.1 GENERAL

The clauses in this part of the specification comprise of the standard clauses detailing the performance specification of materials, method of installation and procedures to be adopted by the sub-contractor.

The entire installation shall be carried out all in accordance with the recommendations of the CIBSE, Building Regulations, Building Control Officer, Water bye laws and all to the complete satisfaction of the local authorities.

3.2 PIPEWORK IN GENERAL

Installation of all pipework shall be as detailed in the accompanying drawings and shall be installed in a professional and workmanlike manner at all times.

All pipework shall be adequately supported on hangers, or brackets with rollers, according to position, in order to permit free movement due to expansion and contraction and the amount of such movement shall be proportioned throughout the system by the provision of anchors at suitable points. All pipework shall be arranged to accommodate without distortion the linear expansion when heated.

Pipes shall be spaced in relation to one another and to the building structure so as not to interfere with any other services and to allow for the required method and thickness of thermal insulation as specified. Clearance between pipework (after insulation has been applied) and finished walls, floors, ceilings and other fixtures shall be adequate for cleaning purposes, future dismantling etc. See table below

Between	and	Clearance (mm)
Pipeline insulated or uninsulated	Wall Finish	25
	Ceiling Finish	50
	Soffit Floor Finish	150
Insulated Pipeline	Adjacent service runs	25
Uninsulated pipeline	Adjacent service runs	50
Adjacent pipelines	Both uninsulated	150
	One uninsulated	75
	Both insulated	25

All exposed pipework runs shall be arranged to present a neat appearance and where practical be parallel both with one another and with the building structure taking due regard however to the grading, venting and draining requirements. All vertical pipework shall be plumb. All pipe runs shall be arranged so that the longest length of tube practicable is used between bends, tees and flanges or unions.

To facilitate routine maintenance the position of all valves, drains and supports shall be determined with this aspect in mind. Grouping of valves, drains, unions, flanges etc., shall be preferred to scattered siting. No joints shall be formed within the thickness of walls, floors or ceilings. Unions or flanges shall be provided generally at a maximum spacing of one every two lengths of tube.

Where pipework is buried, embedded in a floor duct or any other situation where it is not completely accessible for regular inspection of the whole of each joint i.e. above false ceilings, in main riser ducts, roof voids etc., it shall have welded joints and fittings.

All pipework within a boilerhouse or plantroom shall be welded throughout regardless of size, position and whether it is exposed or concealed.

On concealed pipework, if screwed joints to air vents and drain cocks etc., are used then full access shall be provided to allow complete inspection, dismantling, removal, replacement and re-jointing.

Pipes shall be bent around piers and all other projections/recesses and for all off-sets due to the varying thickness of plaster, walls, floors, ceilings and other structural works. Due allowance shall be made in all cases for obtaining full details relating to the skirting heights and floor finishes. All changes of direction formed shall be made with a minimum of loss of local wall thickness. The diameter shall be maintained, crinkled and scored work shall be rejected.

When pipes are held in vices care shall be taken to ensure that the pipe surface is not damaged. Wrench marks on the beads of malleable fittings, valve flats or any other components shall not be accepted. Any pipework or fittings so damaged shall not be fitted.

3.3 PIPEWORK MATERIALS

All pipework shall be installed in accordance with the following tables for each individual service.

Carbon Steel pipework shall not be used under any circumstances. Stainless Steel pipework can be considered as an option to Mild steel pipework installations subject to approval.

All pipe diameters below where indicated "up to" shall be taken as "up to and including" the pipe size indicated.

LPHW Heating	up to 6"	Black Heavyweight Mild Steel Tube to BS EN 10255
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(or and only when specified)

LPHW Heating	up to 54mm	Copper tube to BS EN 1057 R250 (Class / Table X)
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LPHW Cold Feed and	up to 125mm	Copper tube to BS EN 1057 R250 (Class / Table X)
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Water Services	All sizes	Copper tube to BS EN 1057 R250 (Class / Table X)
Incoming MCWS (Buried)	All Sizes	Blue MDPE Polyethylene BS EN 12201
Natural Gas (Internal)	up to 6"	Black Heavyweight Mild Steel Tube to BS EN 10255
Natural Gas (Buried)	All sizes	Yellow MDPE Polyethylene BS EN 1555
Hose Reels	up to 104mm	Copper tube to BS EN 1057 R250 (Class / Table X)
Sprinkler Mains (Internal)	up to 6"	Black Heavyweight Mild Steel Tube to BS EN 10255
Soil and Wastes	All sizes	Terrain UPVC systems BS EN 1329-1
Laboratory Wastes	All sizes	Vulcathene

3.4 PIPEWORK JOINTING

Pipework shall be jointed as indicated in the sections below unless otherwise stated in the particular specification.

In areas where welding would constitute a fire risk over and above the normal accepted level screwed joints may be used, however, only after approval by the Consulting Engineer.

Screwed Joints

In general screwed joints shall be used on exposed black mild steel pipework on view and restricted to use only on pipe sizes less than 2½".

On view shall mean unlagged pipework that can be seen regularly by the occupants of the building. This does not include boilerhouses and plantrooms which shall be strictly welded.

All pipework having screwed joints shall be carefully reamed out before the plain end is screwed. Should a joint be proved defective under subsequent tests, the section of pipework shall be removed and made good. Caulking shall not be permitted.

Welded Joints

In general welded joints shall be used throughout the installation of black mild steel pipework except on exposed pipework on view as above. Pipework in boilerhouse and plantrooms shall be welded throughout.

Pipes shall be prepared for welding with ends sawn or cut off by hand, flame cut by machine or flame cut by hand with subsequent truing by filing or grinding. Welding rods shall in all cases be of good quality copper coated low carbon steel.

Welding in all cases shall be carried out by experienced craftsmen who are in possession of a current certificate issued by an approved authority. The certificate shall be made available for inspection, if requested by the Consulting Engineer or his representative.

During all welding or cutting operations, the welder shall be accompanied by a competent assistant and suitable protection shall be afforded to prevent damage to nearby building fabric and decoration. Welders shall be provided with a portable fire extinguisher for use in an emergency.

The sub contractor shall include for the inspection of all welding on site and/or manufacturers works and the witness of all hydraulic tests.

Flanged Joints

Flanged joints shall be used to connect flanged plant and equipment, to provide sufficient joints for dismantling on pipework larger than 2" and where unions would be impractical.

Flanged joints shall generally be bossed for welding, and shall be screwed when screwed fittings are employed in the area. Flanges that are provided by manufacturers for use with their equipment shall be accepted.

Copper Joints

All joints in copper tube shall be carried out strictly in accordance with the manufacturers recommendations.

Where capillary fittings are used, care shall be taken to ensure that the solder used is suitable for the temperature conditions of the system and is of a lead free nature complying with the water bye laws.

All jointing materials shall be of the non-dezincifiable type, solder droppings and surplus flux shall be removed on completion of the joint.

All jointing operations shall be carried out by a competent and experienced plumber who shall be accompanied by an assistant. Suitable protection shall be afforded to prevent damage to nearby building fabric and decoration. When using blow lamps and burners a portable fire extinguisher shall be provided for use in an emergency.

Joints shall be of the 'Yorkshire' type, capillary.

Crimped fittings may be permitted only at the discretion of the consulting engineer.

3.5 PIPEWORK FITTINGS

Steel Pipework

Screwed tees, bends and elbows for use with standard steel pipes shall be suitable for BS EN 10255 Heavy grade tube. Ends shall be provided with screwed taper threads.

Welding fittings shall be suitable for steel pipe to BS EN 10255 and be manufactured by a forged seamless process from mild steel. Ends of fittings shall have the same bore and wall thickness as that of the tube and shall be bevelled for butt welding.

All bends in pipework shall be formed where practicable and shall be of the long radius pattern. If space for pipework is restricted short radius elbows may be employed. Cutting and shutting shall not be allowed.

Shoes for branch welds shall be used where the branch is 1" and above. Below this size the sweep shall be formed in the pipework. The distance between branch welds shall not be less than twice the diameter of the larger pipe.

Reducing fittings on horizontal pipework shall be of the eccentric pattern fixed so as to give a smooth run to the crown of the pipe. Concentric pattern reducers shall be used on vertical pipework.

Unions or flanges shall be used to facilitate the removal of all valves and plant, drain off cocks shall be provided on the plant side to enable the complete draining of the section prior to removal.

Copper Fittings

All fittings shall be manufactured from non-dezincifiable materials.

Manufactured fittings shall be used where the pipework is on view, a mixture of fittings and pulled bends shall not be permitted. All branch connections shall be by purpose made tees.

Where bending machines are used these shall have smooth clean guides and formers. Pulled bends with any deformity whatsoever resulting in the forming of the bend shall not be accepted.

3.6 SOILS AND WASTE PIPEWORK

The mechanical sub-contractor shall supply and install all above ground drainage in Terrain tube and fittings as indicated on the drawings and in compliance with BS EN 1329-1. In laboratories and where chemical discharge occurs into the soils and wastes system then Vulcathene pipework shall be used throughout.

All tube is to be cut using the appropriate tools and shall be perfectly square. Any angled ends should be filed true. The materials are to be prepared for jointing using Terrain cleaner and jointed using solvent cement.

All pipework shall be adequately supported on hangers and brackets, with due allowance for expansion and contraction. The amount of such movement shall be proportioned throughout the system.

Suitable adapters shall be included to connect the pipework to the underground drainage. Access doors or rodding eyes are to be provided at the base of each stack and at all changes in direction.

Deep seal traps shall be provided on all appliances including anti-vac facilities on appliances with long horizontal runs.

Where SVP's pass through the roof suitable flashings complete with weathering apron shall be provided, the SVP shall also terminate with a bird guard.

Upon completion the mechanical sub-contractor is to fully test the soils and waste system to totally comply with the requirements of the local authority.

3.7 SUPPORTS AND FIXINGS

All pipework shall be properly supported and bracketed and must permit, where required, adequate free and guided movement conforming with the operating conditions applicable. Pipework shall be complete with ball hangers at the top (Pipe rail support) and pipe ring support to allow free movement)

Particular attention must be given to the design and method of support for banks of pipework and heavy plant. The materials, construction, method of fixing and appearance of the brackets must carefully be considered.

Generally pipes shall not be supported from each other but where this is considered necessary and approval has been obtained from the Consulting Engineer this may occur. The brackets installed in this manner shall allow the full removal of any individual pipe where necessary and provision shall be made to allow for unequal expansion where applicable.

Pipework shall not be supported from any items of plant or equipment. All pipework exposed to view and generally around rooms at floor level shall be supported on school-board pattern brackets.

Pipe brackets on exposed copper pipework shall be of the cast brass type. Under no circumstances shall pressed brass brackets be accepted.

Brackets on insulated pipework incorporating a vapour seal shall be fitted with a spacer such as crocodile strip to achieve satisfactory vapour sealing.

Pipework subject to expansion that shall cause distortion of hanger type brackets shall be supported using chair and roller brackets. Multi-service pipework distribution where supported off horizontal channel or Unistrut shall incorporate roller and chair type brackets.

Structural steelwork and roof trusses shall not be drilled either for the passage of pipes or the attachment of brackets, without written permission.

The spacing of all brackets shall conform to those laid down in the CIBSE guides. However, in addition to those centres given in the guides supports shall be provided adjacent to all valves, flanged joints and equipment to prevent undue strain on the pipework should sections need to be removed at a later date.

Typical support centres shall be as noted below:

Pipe Bore (mm)	Maximum Support Spacing (M)					
Nominal	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	5.6	6.0	-	-	3.7	3.7
250	5.0	6.0	-	-	4.5	5.4
300	6.1	10.0	-	-	8.0	10.0
350	10.0	12.0	-	-	-	-

Pipe Bore (mm)	Maximum Support Spacing (M)					
Nominal	Steel Pipe		Copper Pipe		Iron Pipe	
	horizontal	vertical	horizontal	vertical	horizontal	vertical
400	10.5	12.6	-	-	-	-
450	11.0	13.2	-	-	-	-
500	12.0	14.4	-	-	-	-
600	14.0	16.8	-	-	-	-

3.8 PIPE SLEEVES

In all cases where pipework passes through walls, floors and ceilings sleeves shall be provided and correctly built in.

Sleeves shall be made from pipe of the same material and generally using the next size up. For pipes which have a change in direction, over size sleeves shall be used to allow for expansion.

Pipe sleeves when installed on vertical pipework shall be permanently self supporting utilising brackets fitted to the structure. In no circumstances shall the sleeve be allowed to drop prior to building in by the main contractor. Pipe sleeves if practicable can be tacked together in a bank providing minimum clearances are maintained at all time.

The space between the pipe enclosed and its sleeve shall be caulked using mineral wool fire stop and intumescent mastic seal on each side of the sleeve.

Sleeves shall be of the same thickness of the barrier finishing flush on either side. In toilets, kitchens and any other situation where the floor may be sashed, the sleeves shall project 50mm above the finished floor level and a cover plate suitably dressed and fixed to the pipe to prevent water from entering into the sleeve.

On MCWS and chilled water, sleeves shall be large enough to allow the full thickness of thermal insulation to pass through the sleeve, hence maintaining the vapour seal.

Where pipe insulation is carried through pipe sleeve, cut sleeves from material same as pipe one or two sizes larger than pipe and insulation to allow clearance. Do not use sleeves as pipe supports.

Where pipe sleeves pass through fire barriers pack annular space between the pipe and sleeve or insulation and sleeve with a non flammable and fire resistant material to form a fire / smoke stop to match the rating of the wall. Apply 12mm cold mastic seal at both ends within the sleeve

3.9 COVER PLATES

Where exposed to view, pipework passing through walls, floors, ceilings and partitions of occupied rooms shall be fitted with a white plastic cover plate. Such plates shall be split on the diameter be purpose made for the pipe concerned and shall be secured to the wall upon installation.

3.10 EXPANSION AND CONTRACTION

Where necessary provisions shall be made to install expansion loops formed in the pipe runs by means of long radius bends to the necessary dimensions. The loops shall be formed in the mains and each leg of the loop shall be pulled cold to approximately 50% of the estimated expansion of the leg.

Where expansion and contraction cannot be accommodated by selected route, provide pipework loops, as indicated. Limit total stress set up in material of pipe wall, taking into account components due to internal pressure, tension and bending to less than 69 MPa for steel pipelines and less than 51.5 MPa for copper pipe lines.

Where location does not permit sufficient flexibility, provide proprietary devices, as indicated.

EXPANSION COMPENSATORS INSTALLATION:

Provide anchors and guides to contain all movement and resist maximum loads imposed. Install expansion compensators strictly in accordance with manufacturer's instructions.

FLEXIBLE CONNECTIONS INSTALLATION:

Fit rubber bellows as close to source of vibration as practicable. Ensure the pipe at other end of bellows is a fixed point. Install flexible connections strictly in accordance with manufacturer's instructions.

Ensure flexible connections are tied when the plant is on vibration isolation mountings. Expansion bellows and joints shall be installed in the pipework where shown on the drawings, these shall be either single or double, screwed or flanged as specified.

Bellows shall be installed with due allowance having been made for cold draw which shall vary according to the type and length of bellow proposed and the temperature of the installation.

Where an expansion facility is provided guides shall be employed to ensure correct movement of the pipe and shall be fitted not more than four pipe diameters from the first expansion joint and not more than twelve pipe diameters between this guide and the next.

Direct movement of expansion and contraction from pipe anchor points towards loops, bellows, or flexible inserts. Ensure that trust is linear to the axis of the pipe.

Apply a friction reducing material between metal faces subject to movement.

Anchor points are to be constructed to resist axial stress transmitted by flexure of horizontal and vertical pipe runs or loading on vertical pipes assuming that unbalanced forces exist at all anchor points, even when these are situated in intermediate positions between two expansion loops or bellows. Use similar or compatible materials to the attached pipe.

Provide and fix all associated backing plates, nuts, washers and bolts for attachment to or building into building structure; ensure structure is suitable for transmitted stress. Set out and line up anchors accurately in position. Inspect final grouting into building structure

Branch connections are to be taken from the top or bottom of both flow and return mains with due regard to air venting and draining. Branches shall have incorporated in them three bends before passing into sub-ducts, trenches, service voids etc. The branches shall be so arranged as to take up the movement of the mains without putting any strain on the length of the branches.

3.11 AIR VENTING AND DRAINING

Full provisions shall be made for venting all sections of the pipework within the installation. This shall generally be achieved using purpose made air vents fitted into tees.

Air bottles shall be provided and installed equivalent to the bore size of the pipe and of at least 100mm long with a copper extension pipe terminated to a manual vent cock located at an easily accessible location.

Automatic air vents shall be provided and installed complete with copper outlet pipe from the valve to a tundish in an adjacent drain line or to another suitable location. Details of automatic air vents to be used shall be submitted by the contractor for approval prior to installation. They shall comply with the following:

Construction - Bronze or DZR copper alloy body with threaded inlet to BS 21 and BS EN 10226-1. Solid polypropylene float and air release valve. Ensure valve is self closing.

Operating Conditions - Maximum temperature 130°C. Maximum pressure 10 bar.

Options - Provide connection for piping away released air and integral non-return valve where indicated.

Drain points shall be provided on all items of plant/equipment and at all low points in the system to allow full and complete draining. Drain points shall also be provided on the branch side of all isolating valves whether shown on the drawing or not and also to the system side of the incoming MCWS supply after the valve.

3.12 PROTECTIVE PAINTING

All ferrous materials including pipework, fittings, sundry iron and steel brackets shall be primed before despatch to site. Protective coatings removed or damaged shall be thoroughly wire brushed and cleaned before re-priming. All ferrous materials shall be applied with two coats of red lead oxide paint immediately after erection.

All gas pipework within boilerhouses and plantrooms shall be painted by the sub contractor; after suitable priming, with two coats of yellow ochre BS 4800 08 C 35' paint. All remaining gas pipework shall be identified by means of identification bands as later described.

3.13 VENTING AND PURGING OF GAS

The sub contractor shall include for the supplying and installing of suitable hoses during commissioning to vent and purge gas to atmosphere at high level and away from opening windows, fully conforming with the Gas Safe Regulations.

3.14 VALVES AND COCKS

In addition to the valves and cocks shown on the drawings the sub contractor shall include for the installation of sufficient valves and strainers, as detailed below, to satisfy the Consulting Engineer that the following facilities shall be available.

- a) Regulation of low and high temperature hot water using suitable commissioning stations, which shall be at minimum, one fixed orifice valve and one double regulating valve. All main commissioning sets and all mixing valves shall have upstream fine mesh strainers fitted
- b) Isolation and regulation of all main branches
- c) Isolation and regulation of 'dead legs' and sanitary appliances for both hot and cold services by stopcocks on MCWS and gate valves on HWS and TCWS
- d) Isolation of gas services by gas cocks, ball valves or butterfly valves
- e) Isolation of pressure and altitude gauges by means of a gauge cock

Non return valves shall be fitted where plant operates on an automatic changeover basis or where flow reversal may occur

The sub contractor shall ensure that all valves, stopcocks, fittings etc., are suitable for the temperature, working pressure and fluids of the system involved.

Valves shall be as manufactured by Crane, Hattersley, Oventrop, T&A or equal and approved.

All valves shall be, as far as practicable, of the same manufacture and style to provide uniformity of appearance and ease of maintenance.

- Install pipeline ancillaries in accordance with manufacturers recommendation and to BS 6683
- Provide tee handled short shank keys suitable for each size of valve spindle shank
- Provide lever pattern keys suitable for each draincock
- Provide loose hose unions for drain cocks

KEYS FOR SPINDLE SHANK VALVES:

Provide tee handled short shank keys suitable for each size of valve spindle shank.

DRAIN COCKS:

Provide lever pattern keys suitable for each drain cock and loose hose unions for drain cocks.

LOCATION OF THERMOSTATIC RADIATOR VALVES:

Install thermostatic radiator valves in an area which reflects the space temperature
Ensure that they are not behind curtains or enclosed in heating or radiator panels

POSITIONING OF COMPONENTS:

Locate flow and pressure measurement valves to ensure manufacturer's recommended straight length of pipe upstream and downstream of valve is provided

POSITIONING OF DOUBLE REGULATING VARIABLE ORIFICE VALVE:

Install double regulating variable orifice valve to ensure equivalent of 10 diameters of straight pipe upstream and 5 diameters downstream of double regulating valve

POSITIONING OF CONTROL COMPONENTS:

Install pipeline control components in accordance with manufacturer's instructions and in positions indicated

Insulation - Where control components are incorporated in insulated pipelines provide details of insulation method proposed for approval

Supports - Arrange supports for control components to ensure no strain is imposed on components

Access - Arrange control components to ensure adequate access for operation and maintenance

POSITIONING OF CONTROL COMPONENTS:

- Install pipeline control components in accordance with manufacturer's instructions and in positions indicated
- Insulation - Where control components are incorporated in insulated pipelines provide details of insulation method proposed, for approval
- Supports - Arrange supports for control components to ensure no strain is imposed on components. Access - Arrange control components to ensure adequate access for operation and maintenance

VALVE STUFFING BOXES:

Adjust glands of all stuffing boxes at normal plant operating temperature and pressure in accordance with manufacturer's instructions. Ensure that valve action is not impaired by over tightening.

DISCHARGE CONNECTIONS, SAFETY VALVES:

Fit pipework connections, where indicated, to provide discharge connection to safety and relief valves terminating at a safe discharge point

DISCHARGE CONNECTIONS, VENT COCKS:

Fit pipework connections, where indicated, to provide discharge connection to vent cocks terminating 150mm above floor level

Valves shall comply with the following specification clauses. Valve types shall be agreed with the consulting engineer before installation commences / at the time of tendering.

2015A STOP VALVES TO BS EN 1213 FOR POTABLE WATER SUPPLIES - COMPRESSION ENDS FOR COPPER:

Pattern - Straight

Material - copper alloy

Flow rate class - VA (straight and angle pattern stopvalves)

End connections - Compression to BS EN 1254-2

**2015C STOP VALVES TO BS EN 1213 FOR POTABLE WATER SUPPLIES -
CAPILLARY:**

Pattern - Straight

Material - copper alloy

Flow rate class VA (straight and angle pattern stopvalves)

End connections - Capillary to BS EN 1254-1

**2015D STOP VALVES TO BS EN 1213 FOR POTABLE WATER SUPPLIES -
THREADED:**

Pattern - Straight

Material - copper alloy

Flow rate class - VA (straight and angle pattern stopvalves).

End connections - Threaded to BS 21 and BS EN 10226-1

2020A THREADED ENDS GATE VALVES TO BS EN 12288:

Series - B

Gate valve type - Solid or split wedge

Ends - Threaded to BS EN ISO 228-1 or ISO 7-1

Stem - Inside screw non-rising stem.

Trim material - Manufacturer's standard

Operation - Handwheel

2020B COMPRESSION ENDS GATE VALVES TO BS EN 12288:

Series - B

Gate valve type - Solid or split wedge

Ends - Compression to BS EN 1254-2

Stem - Inside screw non-rising stem

Trim material - Manufacturer's standard

Operation – Handwheel

2020C FLANGED ENDS GATE VALVES TO BS EN 12288:

Series - B

Gate valve type - Solid or split wedge

Ends - Flanged to BS EN 1092-3

Stem - Inside screw non-rising stem

Trim material - Manufacturer's standard

Operation - Handwheel

2030A FLANGED GATE VALVES TO BS EN 1171:

Valve type - Solid or split wedge.

Seat - Metal

Ends - Flanged to BS EN 1092-2

Body and bonnet material - Grey cast iron
Trim category - Copper alloy faced
Operation – Handwheel

2040A THREADED END GLOBE VALVES TO BS 5154: Series – B

Pattern - Straight
Ends - Threaded to BS 21 and BS EN 10226-1. Stem - Inside screw rising stem
Trim material - Manufacturer's standard
Operation - Handwheel
Options - Non-metallic renewable seat/disk rings

2040B FLANGED GLOBE VALVES TO BS 5154:

Series - B
Pattern - Straight
Ends - Flanged to BS EN 1092-3
Stem - Inside screw rising stem
Trim material - Manufacturer's standard
Operation - Handwheel
Options - Non-metallic renewable seat/disk rings

2040C COMPRESSION GLOBE VALVES TO BS 5154:

Series - B
Pattern - Straight
Ends - Compression fitting to BS EN 1254-2
Stem - Inside screw rising stem
Trim material - Manufacturer's standard.
Operation - Handwheel
Options - Non-metallic renewable seat/disk rings

2040D COMPRESSION GLOBE VALVES TO BS 5154 FOR PLASTIC PIPE:

Series - B
Pattern - Straight
Ends - Compression fitting to BS EN 1254-3 or BS 864-5
Stem - Inside screw rising stem
Trim material - Manufacturer's standard
Operation – Handwheel

2040D COMPRESSION GLOBE VALVES TO BS 5154 FOR PLASTIC PIPE:

Options - Non-metallic renewable seat/disk rings

2050A FLANGED GLOBE VALVES TO BS EN 13789:

Pattern - Straight

Stem - Rising stem outside screw
Ends - Flanged to BS EN 1092-2
Material - Manufacturer's standard

2060A PARALLEL SLIDE VALVES TO BS EN 1171:

Ends - Flanged BS EN 1092-2
Stem - Rising stem
Valve faces - Stainless steel disc and seat

2070A FLANGED STOP VALVES - GATE TYPE TO BS EN 1984:

Pattern - Full bore or reduced bore
Materials - Cast steel body and materials to suit fluid and operating conditions
Ends - Flanged
Operation - Handwheel

2070D THREADED STOP VALVES - GATE TYPE TO BS EN 1984:

Pattern - Full bore or reduced bore
Materials - Cast steel body and materials to suit fluid and operating conditions.
Ends threaded to BS 21 and BS EN 10226-1
Operation - Handwheel

2080A THREADED END BALL TYPE VALVES - SCREW DRIVER/KEY OPERATED:

Materials - Bronze or DZR copper alloy body.
Ends - Threaded to BS 21 and BS EN 10226-1
Chrome or nickel plated DZR sphere with full bore flow aperture. PTFE seats and stem seals. Anti-blowout stem
Operation - Screw driver operated or key operated

2080B COMPRESSION END BALL TYPE VALVES - SCREW DRIVER/KEY OPERATED:

Materials - Bronze or DZR copper alloy body.
Ends - Compression fittings to BS EN 1254-2
Chrome or nickel plated DZR sphere with full bore flow aperture. PTFE seats and stem seals. Anti-blowout stem
Operation - Screw driver operated or key operated

2080C THREADED END BALL TYPE VALVES - LEVER OPERATED:

Materials - Bronze or DZR copper alloy body.
Ends - Threaded to BS 21 and BS EN 10226-1
Chrome or nickel plated DZR sphere with full bore flow aperture. PTFE seats and stem seals. Anti-blowout stem
Operation - lever operated

2080D COMPRESSION END BALL TYPE VALVES - LEVER OPERATED:

Materials - Bronze or DZR copper alloy body.

Ends - Compression fittings to BS EN 1254-2.

Chrome or nickel plated DZR sphere with full bore flow aperture. PTFE seats and stem seals. Anti-blowout stem.

Operation - lever operated.

2080E THREADED END BALL TYPE VALVES - LOCKSHIELD:

Materials - Bronze or DZR copper alloy body.

Ends - Threaded to BS 21 and BS EN 10226-1

Chrome or nickel plated DZR sphere with full bore flow aperture. PTFE seats and stem seals. Anti-blowout stem

Operation - lockshield

2080F COMPRESSION BALL TYPE VALVES - LOCKSHIELD:

Materials - Bronze or DZR copper alloy body.

Ends - Compression fittings to BS EN 1254-2

Chrome or nickel plated DZR sphere with full bore flow aperture. PTFE seats and stem seals. Anti-blowout stem

Operation - lockshield

2090A LEVER OPERATED BUTTERFLY VALVES TO BS EN 593 BETWEEN FLANGES:

Construction - Provide controlled elastomer compression on flange faces; semi-lugged wafer type design, for installation between flanged pipework connections, body to suit BS EN 1092-2

Provide lever and gear operated valves with long body neck for lagging clearance. Seat - Bonded

Materials - Cast iron body; stainless steel shaft; aluminium bronze disc; EPDM seat

Operation - Lever and graduated notch plate

2090B GEAR OPERATED BUTTERFLY VALVES TO BS EN 593 BETWEEN FLANGES:

Construction - Provide controlled elastomer compression on flange faces; semi-lugged wafer type design, for installation between flanged pipework connections, body to suit BS EN 1092-2

Provide lever and gear operated valves with long body neck for lagging clearance. Seat - Bonded

Materials - Cast iron body; stainless steel shaft; aluminium bronze disc; EPDM seat

Operation - gear operated

2090C LEVER OPERATED BUTTERFLY VALVES BETWEEN MECHANICAL JOINTS:

Construction - Wafer type design, for installation between mechanical joints, body with grooved ends

Provide lever operated valves with long body neck for lagging clearance

Seat – Bonded

Materials - Ductile iron body; stainless steel shaft; electroless nickel coated ductile iron disc; EPDM seat

Operation - Lever and graduated notch plate

2090D GEAR OPERATED BUTTERFLY VALVES BETWEEN MECHANICAL JOINTS:

Construction - Wafer type design, for installation between mechanical joints, body with grooved ends

Provide gear operated valves with long body neck for lagging clearance

Seat - Bonded

Materials - Ductile iron body; stainless steel shaft; electroless nickel coated ductile iron disc; EPDM seat

Operation - gear operated

2110A STOP VALVES - KEY OPERATED SLUICE TYPE A TO BS 5163-1 AND BS 5163-2:

Valve type - A

Seat - Resilient or metal seated

Stem seal - Stuffing box and gland; injector packing foil; or toroidal sealing rings (O-rings)

Operation - T key

Materials - Manufacturer's standard and WRAS approved

Options - Stem cap

2110B STOP VALVES - KEY OPERATED SLUICE TYPE B TO BS 5163-1 AND BS 5163-2:

Valve type - A

Seat - Resilient or metal seated

Stem seal - Stuffing box and gland; injector packing foil; or toroidal sealing rings (O-rings)

Operation - T key

Materials - Manufacturer's standard and WRAS approved

Options - Stem cap

2210A LEVER OPERATED REGULATING BUTTERFLY VALVES TO BS EN 593 BETWEEN FLANGES:

Construction - Provide controlled elastomer compression on flange faces; semi-lugged wafer type design, for installation between flanged pipework connections, body to suit BS EN 1092-2. Provide lever and gear operated valves with long body neck for lagging clearance

Seat - Bonded seat

Materials - Cast iron body; stainless steel shaft; aluminium bronze disc; EPDM seat.

Operation - Infinitely variable setting with travel stops and indicator, lever operation

2210B GEAR OPERATED REGULATING BUTTERFLY VALVES TO BS EN 593 BETWEEN FLANGES:

Construction - Provide controlled elastomer compression on flange faces; semi-lugged wafer type design, for installation between flanged pipework connections, body to suit BS EN 1092-2

Provide lever and gear operated valves with long body neck for lagging clearance

Seat - Bonded seat

Materials - Cast iron body; stainless steel shaft; aluminium bronze disc; EPDM seat.

Operation - Infinitely variable setting with travel stops and indicator, gear operation

2210C LEVER OPERATED REGULATING BUTTERFLY VALVES TO BS EN 593 BETWEEN MECHANICAL JOINTS:

Construction - Installation between mechanical joints with grooved ends

Provide lever operated valves with long body neck for lagging clearance

Seat - Bonded seat

Materials - Ductile iron body; stainless steel shaft; rubber coated ductile iron disc; EPDM seat

Operation - Infinitely variable setting with travel stops and indicator, lever operation

2210D GEAR OPERATED REGULATING BUTTERFLY VALVES TO BS EN 593 BETWEEN MECHANICAL JOINTS:

Construction - Installation between mechanical joints with grooved ends

Provide gear operated valves with long body neck for lagging clearance

Seat - Bonded seat

Materials - Ductile iron body; stainless steel shaft; rubber coated ductile iron disc; EPDM seat

Operation - Infinitely variable setting with travel stops and indicator, gear operation

2220A THREADED END DOUBLE REGULATING VALVES TO BS 7350, COPPER ALLOY:

BS 7350, section 3.1

Ends - Threaded to BS 21 and BS EN 10226-1

Material - Bronze or DZR copper alloy to BS 5154

Series B; oblique or Y pattern; inside screw non-rising stem; manufacturer's standard trim material

Options - Provide drain plug facility; independent means for positive isolation on pressure tapping or adapter; and test and manufacturer's certificates as indicated

2220B FLANGED DOUBLE REGULATING VALVES TO BS 7350, COPPER ALLOY:

BS 7350, section 3.1

Ends - Flanged to BS EN 1092-2

Material - Bronze or DZR copper alloy to BS 5154

Series B; oblique or Y pattern; inside screw non-rising stem; manufacturer's standard trim material

Options - Provide drain plug facility; independent means for positive isolation on pressure tapping or adapter; and test and manufacturer's certificates as indicated

2220C FLANGED DOUBLE REGULATING VALVES TO BS 7350, CAST IRON:

BS 7350, section 3.1

Ends - Flanged to BS EN 1092-2

Material - Cast iron to BS EN 13789

Oblique or Y pattern; copper alloy, nickel alloy or resilient valve face; rising stem outside screw or non-rising stem inside screw; manufacturer's standard materials.

Options - Provide drain plug facility; independent means for positive isolation on pressure tapping or adapter; and test and manufacturer's certificates as indicated.

2230A THREADED ENDS FLOW MEASUREMENT DEVICES TO BS 7350, COPPER ALLOY:

BS 7350, section 3.2 - type 3

A fixed orifice either integral with or as a fixed orifice fitting close coupled to a double regulating globe valve

Ends - Threaded to BS 21 and BS EN 10226-1

Material - Double regulating globe valve, bronze or DZR copper alloy to BS 7350 table 6.

Options - Independent means for positive isolation on pressure tapping or adapter

2230B FLANGED ENDS FLOW MEASUREMENT DEVICES TO BS 7350 TYPE 3, COPPER ALLOY:

BS 7350, section 3.2 - type 3

A fixed orifice either integral with or as a fixed orifice fitting close coupled to a double regulating globe valve

Ends - Flanged to BS EN 1092-3

Material - Double regulating globe valve, bronze or DZR copper alloy to BS 7350 table 6

Options - Independent means for positive isolation on pressure tapping or adapter

2230C FLANGED FLOW MEASUREMENT DEVICE TO BS 7350 CAST IRON, TYPE 3:

BS 7350, section 3.2 - type 3

A fixed orifice either integral with or as a fixed orifice fitting close coupled to a double regulating globe valve

Ends - Flanged to BS EN 1092-2

Material - Double regulating globe valve to BS EN 13789 and close coupled fixed orifice fitting to BS 7350, table 6

Options - Independent means for positive isolation on pressure tapping or adapter

2230D GROOVED ENDS FLOW MEASUREMENT DEVICE TO BS 7350 CAST IRON, TYPE 3:

BS 7350, section 3.2 - type 3

A fixed orifice either integral with or as a fixed orifice fitting close coupled to a double regulating globe valve

Ends - Grooved

Material - Double regulating globe valve to BS EN 13789 and close coupled fixed orifice fitting to BS 7350, table 6

Options - Independent means for positive isolation on pressure tapping or adapter

2230E THREADED ENDS FLOW MEASUREMENT DEVICES TO BS 7350 TYPE 4, COPPER ALLOY:

BS 7350, section 3.2 - type 4, variable orifice valve

Ends - Threaded to BS 21 and BS EN 10226-1

Material - Variable orifice, double regulating globe valve, bronze or DZR copper alloy to BS 5154 series B

Options - Independent means for positive isolation on pressure tapping or adapter

2230F FLANGED FLOW MEASUREMENT DEVICES TO BS 7350 TYPE 4, COPPER ALLOY:

BS 7350, section 3.2 - type 4, variable orifice valve

Ends - Flanged to BS EN 1092-3

Material - Variable orifice, double regulating globe valve, bronze or DZR copper alloy to BS 5154 series B

Options - Independent means for positive isolation on pressure tapping or adapter

2230G FLOW MEASUREMENT DEVICES TO BS 7350 TYPE 4, CAST IRON:

BS 7350, section 3.2 - type 4, variable orifice valve

Ends - Flanged to BS EN 1092-2

Material - Variable orifice, double regulating globe valve, cast iron to BS EN 13789

Options - Independent means for positive isolation on pressure tapping or adapter

2260A RADIATOR VALVES TO BS 2767 (TYPE4):

Material - Bronze or brass copper alloy body.

Pattern - Angle or straight to suit application

Straight - Threaded to BS 21 and BS EN 10226-1 or compression to BS EN 1254-2 to suit pipework as indicated

Angle - Threaded to BS 21 and BS EN 10226-1 with one end internal and other end external with union nut and tail pipe; or compression joint to BS EN 1254-2 one end and other end externally threaded to BS 21 and BS EN 10226-1 with union nut and tail pipe to suit pipework as indicated

Options - Fit wheel valves on flow connections to radiators, and other heat emitters, without thermostatic radiator valves. Fit lockshield valves on return connections

Note:- All radiator thermostatic valves to be Danfoss RA-DV type.

2270A THERMOSTATIC RADIATOR VALVES TO BS EN 215 TABLE A.1:

Material to A.1

Pattern - Straight or angle pattern to suit application

Dimensions - Table A.1 series D

Thermostatic valve type - Integral sensor unless otherwise indicated

2270B THERMOSTATIC RADIATOR VALVES TO BS EN 215 TABLE A.2:

Material to Annex A

Pattern - Straight or angle pattern to suit application

Dimensions - Table A.2 series F

Thermostatic valve type - Integral sensor unless otherwise indicated

2270D THERMOSTATIC RADIATOR VALVES TO BS EN 215 TABLE A.4:

Material to Annex A

Pattern - Straight or angle pattern to suit application

Dimensions - Table A.4 series GB

Thermostatic valve type - Integral sensor unless otherwise indicated

2270E TAMPER PROOF THERMOSTATIC RADIATOR VALVES TO BS EN 215 TABLE A.1:

Material to Annex A

Pattern - Straight or angle pattern to suit application

Provide tamper proof TRV's

Dimensions - Table A.1 series D

Thermostatic valve type - Integral sensor unless otherwise indicated

2270F TAMPER PROOF THERMOSTATIC RADIATOR VALVES TO BS EN 215 TABLE A.2:

Material to Annex A

Pattern - Straight or angle pattern to suit application

Provide tamper proof TRV's

Dimensions - Table A.2 series S

Thermostatic valve type - Integral sensor unless otherwise indicated

THERMOSTATIC CONTROL VALVES:

Operation

- Two way
- Three way
- High limit
- High limit with manual reset

Material

- Brass
- Copper alloy to BS EN 1982

- Cast iron to BS EN 1561 and of tensile strength 140N/mm² or 170N/mm², using separate cast sample test method
- Cast steel to BS EN 10222 and BS EN 10213
- Connections
- Threaded to BS 21 and BS EN 10226-1
- Flanged to BS EN 1092-3 PN
- Cast Steel, flanged to BS EN 1092-1 PN
- Cast iron, flanged to BS EN 1092-2 PN

Ancillaries

- Position indicator
- Locking device
- Strainer
- Moisture trap
- Safety valve
- Temperature sensor
- Integral thermostat with an alpha/numeric set-point indicator and locking facility, where indicated
- Remote sensor with an alpha/numeric/temperature set-point indicator; integral locking facility, where indicated; and capillary connections between sensor and valve

2315A OPEN/CLOSE CONTROL BALL VALVES:

Valve - Open/Close valve

Rotary Actuator - Open/close

Material - Nickel-plated brass; stainless steel ball; PTFE seal; stainless steel spindle; EPDM spindle seal

Connections - Threaded to BS 21 and BS EN 10226-1

Ancillaries - Lever for manual operation

2315B TWO WAY CONTROL BALL VALVES:

Valve - Two way

Rotary Actuator - Modulating

Material - Nickel-plated brass; stainless steel ball; PTFE seal; stainless steel spindle; EPDM spindle seal. Connections - Threaded to BS 21 and BS EN 10226-1

Ancillaries - Lever for manual operation

2315C THREE WAY CONTROL BALL VALVES:

Valve - Three way control valve

Rotary Actuator - Modulating

Material - Nickel-plated brass; stainless steel ball; PTFE seal; stainless steel spindle; EPDM spindle seal

Connections - Threaded to BS 21 and BS EN 10226-1

Ancillaries - Lever for manual operation

2320A THREADED ENDS SWING CHECK VALVES TO BS 5154:

Series B; horizontal pattern.
Ends - Threaded to BS 21 and BS EN 10226-1
Trim material - Manufacturer's standard.

2320B FLANGED SWING CHECK VALVES TO BS 5154:

Series B; horizontal pattern
Ends - Flanged to BS EN 1092-3
Trim material - Manufacturer's standard

2330A FLANGED SWING CHECK VALVES TO BS EN 12334:

Check valve type to BS EN 736-1 - Swing
Body type - Flanged
Ends - Flanged to BS EN 1092-2
Body and cover materials - Grey cast iron or SG cast iron. Orientation of pipework - Horizontal or vertical

2330B WAFER BODY SWING CHECK VALVES TO BS EN 12334:

Check valve type to BS EN 736-1 - Swing
Body type - Wafer
Body and cover materials - Grey cast iron or SG cast iron. Orientation of pipework - Horizontal or vertical

2330C FLANGED LIFT CHECK VALVES TO BS EN 12334:

Check valve type to BS EN 736-1 - Lift
Body type - Flanged
Ends - Flanged to BS EN 1092-2
Body and cover materials - Grey cast iron or SG cast iron. Orientation of pipework - Horizontal or vertical

2330D WAFER BODY LIFT CHECK VALVES TO BS EN 12334:

Check valve type to BS EN 736-1 - Lift
Body type - Wafer
Body and cover materials - Grey cast iron or SG cast iron. Orientation of pipework - Horizontal or vertical

2340A FLANGED SWING CHECK VALVES TO BS EN 12334:

Wafer pattern design suitable for installation between flanged pipework, body to suit BS EN 1092-2
Disc - Double disc
Type - Light spring type
Seat - Bonded

Materials - Cast iron body; bronze disc; EPDM seat

2385A COMBINED CHECK AND ANTI-VACUUM DEVICE TO PREVENT CONTAMINATION OF WATER BY BACKFLOW TO BS EN 14451:

Standard - BS EN 14451 combined check and anti-vacuum valves. WRAS approval

Ends - Compression connections to BS EN 1254-2

2390A COMBINED CHECK AND ANTI-VACUUM TYPE ANTI BACK SYPHONAGE VALVES:

Bronze or DZR copper alloy body assembly with compression connections to BS EN 1254-2

Pattern - In-line pattern

Components - Stainless steel domed air inlet. Non-return valve with plastic body, rubber actuator and stainless steel to plastic seal. WRAS approval

2430A SAFETY VALVES TO BS EN ISO 4126-1, COPPER ALLOY, SINGLE SPRING:

Material - Bronze or DZR copper alloy body.

Ends - Threaded to BS 21 and BS EN 10226-1. Spring type - Single spring loaded, high lift type

2430B SAFETY VALVES TO BS EN ISO 4126-1, COPPER ALLOY, DOUBLE SPRING:

Material - Bronze or DZR copper alloy body.

Ends - Threaded to BS 21 and BS EN 10226-1. Spring type - Double spring loaded, high lift type

2440A DRAIN COCKS, THROUGHWAY GLAND COCK:

Bronze body threaded male to BS 21 and BS EN 10226-1

Tapered plug with square shank for loose lever; bolted gland; strap and blank cap screwed on hand tight.

Outlet to accept hose union

2450 DRAIN COCKS - SCREWDOWN TO BS 2879, TYPE 1:

Bronze body threaded male to BS 21 and BS EN 10226-1

Screw down plug with square shank for loose lever

Serrated outlet to accept hosepipe, fixed or union pattern

Lockshield to accept key

2460 DRAIN COCKS - BALL TYPE:

Bronze or DZR copper alloy body; chrome-plated DZR ball; PTFE seats and stem seals; blow-out proof stem; strap and blank cap screwed on hand tight; serrated outlet to accept hose pipe

Lockshield key operated

2470 VENT COCKS - TWO WAY GLAND COCK TYPE:

Bronze body threaded to BS 21 and BS EN 10226-1; tapered plug with square shank for loose lever; plug position indicator; bolted gland

2480 VENT COCKS - BALL TYPE:

Bronze or DZR copper alloy body; chrome-plated DZR ball; PTFE seats and stem seals; blow-out proof stem

Permanently identified ports in T-configuration

Lever operated

2490 VENT COCKS - THREE WAY GLAND COCK TYPE:

Bronze body threaded to BS 21 and BS EN 10226-1; tapered plug with square shank for loose lever; plug position indicator; port markings to indicate inlet, vent, waste; bolted gland

Port configuration, T port

2500A THREE WAY PLUG VALVE VENT COCKS - WRENCH OPERATED:

Cast iron body, plug and bottom cover

PTFE thrust washer.

Ends - Flanged to BS EN 1092-2

T port configuration

Wrench operation

2500B THREE WAY PLUG VALVE VENT COCKS - GEAR OPERATED:

Cast iron body, plug and bottom cover. PTFE thrust washer.

Ends - Flanged to BS EN 1092-2

T port configuration

Gear operation

2510A AUTOMATIC AIR VENTS, FLOAT TYPE:

Construction - Bronze or DZR copper alloy body with threaded inlet to BS 21 and BS EN 10226-1. Solid polypropylene float and air release valve. Ensure valve is self closing

Operating Conditions - Maximum temperature 130°C

Maximum pressure 10 bar

Options - Provide connection for piping away released air and integral non-return valve where indicated

2515A MICROBUBBLE TEMPERATURE DIFFERENTIAL DEAERATORS:

Construction - Vertical mild steel housing incorporating internal spiral wound copper mesh system. Provide automatic air release mechanism

Ends - Line size with flanges to BS EN 1092-1, PN 16

Operating conditions - Maximum temperature 110°C, maximum pressure 10 bar

2520A LTHW PRESSURE DIFFERENTIAL DEAERATORS:

Unit - Provide a self circulating unit connected to the system by two 15mm connections at least 500mm apart

Isolation - Provide valves to isolate the vessel from the main system

Operating conditions - Maximum temperature 110°C, maximum pressure 10 bar

2520B CHILLED WATER PRESSURE DIFFERENTIAL DEAERATORS:

Unit - Provide a self circulating unit connected to the system by two 15mm connections at least 500mm apart. Insulate to prevent condensation

Isolation - Provide valves to isolate the vessel from the main system

Operating conditions - Maximum temperature 110°C, maximum pressure 10 bar

2521A CENTRIFUGAL AIR SEPARATORS:

Construction - Vertical steel housing with offset inlet and outlet ports to remove bubbles via centrifugal force

Provide automatic air release mechanism

Ends - Line size with flanges to BS EN 1092-1, PN 16

Operating conditions - Maximum temperature 110°C, maximum pressure 10 bar

2522A GRAVITATION DIRT SEPARATORS:

Construction - Vertical mild steel housing with internal reservoir, sludge pipe, perforation plate and automatic air release mechanism

Ends - Line size with flanges to BS EN 1092-1, PN 16

Operating conditions - Maximum temperature 110°C, maximum pressure 10 bar

2524A MICROBUBBLE AIR AND DIRT SEPARATORS:

Construction - Vertical steel housing with internal large surface area mechanism to remove microbubbles via coalescence effect

Fitted with dirt drain at its lowest point for removing dirt that sinks, and fitted with a dirt drain valve on the side of the housing for removing dirt that floats on the water

Provide automatic air release mechanism

Ends - Line size with flanges to BS EN 1092-1, PN 16

Operating conditions - Maximum temperature 110°C, maximum pressure 10 bar

2550 STEAM TRAPS - THERMOSTATIC TYPE, BI-METALLIC:

Steel body and cover with threaded ends to BS 21 and BS EN 10226-1, suitable for horizontal in-line mounting
Thermostatic element in corrosion resistant multiple cross disc type bimetal stainless steel.
Integral stainless steel strainer

2580 STEAM TRAPS - INVERTED BUCKET TYPE:

Cast iron body with threaded ends to BS 21 and BS EN 10226-1
Stainless steel bucket and internal components
Integral strainer with access plug and stainless steel element
Bolted cover with gasket

2610A STEEL EXPANSION LOOPS:

Provide expansion loop in material and finish of associated pipeline
Size to limit stress set up in material of pipe wall to 69 MPa
Forge bend from a single length of pipe or join by welding fittings if expansion loops are too large to manufacture in one piece
Where indicated, galvanize after manufacture

2630A THREADED END EXPANSION COMPENSATORS, AXIAL BELLOWS:

Ends - Threaded to BS 21 and BS EN 10226-1
Bellows - Stainless steel, multi ply or single-ply construction fitted with stainless steel inner sleeves
Operation - Supply expansion joints capable of not less than 2000 complete reversals of movement at the given working conditions; and of withstanding a pressure test of 1.5 times the design pressure without deformation

2630B FLANGED EXPANSION COMPENSATORS, AXIAL BELLOWS:

Ends - Flanged to BS EN 1092-1
Bellows - Stainless steel, multi-ply or single-ply construction fitted with stainless steel inner sleeves
Operation - Supply expansion joints capable of not less than 2000 complete reversals of movement at the given working conditions; and of withstanding a pressure test of 1.5 times the design pressure without deformation

2630D THREADED ENDS EXPANSION COMPENSATORS, ARTICULATED BELLOWS:

Ends - Threaded to BS 21 and BS EN 10226-1
Bellows - Stainless steel, multi-ply or single-ply construction fitted with stainless steel inner sleeves
Operation - Supply expansion joints capable of not less than 2000 complete reversals of movement at the given working conditions; and of withstanding a pressure test of 1.5 times the design pressure without deformation

2630E FLANGED EXPANSION COMPENSATORS, ARTICULATED BELLOWS:

Ends - Flanged to BS EN 1092-1

Bellows - Stainless steel, multi-ply or single-ply construction fitted with stainless steel inner sleeves

Operation - Supply expansion joints capable of not less than 2000 complete reversals of movement at the given working conditions; and of withstanding a pressure test of 1.5 times the design pressure without deformation

2650A FLANGED EPDM RUBBER FLEXIBLE CONNECTIONS UP TO 10 BAR AND 100 DEGREE C:

Material - EPDM rubber with wire reinforced cuffs

Steel reinforcement within the body

Marking - Mould date of manufacture on bellows

Show manufacturer and type

Ends - Flanges to BS EN 1092-1 that can swivel and are removable

Operation - Ensure flexible connections have a design life of 120 months at 100°C

Provide tie bars with rubber top hat washers where working pressure exceeds 4 bar

Supply threaded tie bars with adjustable length

Ensure flexible connections are tied when the plant is on vibration isolation mountings

2650B THREADED END EPDM RUBBER FLEXIBLE CONNECTIONS UP TO 10 BAR AND 100 DEGREE C:

Material - EPDM rubber with wire reinforced cuffs

Steel reinforcement within the body

Marking - Mould date of manufacture on bellows

Show manufacturer and type

Ends - Threaded to BS 21 and BS EN 10226-1 with one union end

Operation - Ensure flexible connections have a design life of 120 months at 100°C

Provide tie bars with rubber top hat washers where working pressure exceeds 4 bar

Supply threaded tie bars with adjustable length

Ensure flexible connections are tied when the plant is on vibration isolation mountings

2650D FLANGED EPDM RUBBER FLEXIBLE CONNECTIONS UP TO 10 BAR AND 70 DEGREE C:

Material - EPDM rubber with wire reinforced cuffs

Synthetic fibre reinforcement within the body

Marking - Mould date of manufacture on bellows

Show manufacturer and type

Ends - Flanges to BS EN 1092-1 that can swivel and are removable

Operation - Ensure flexible connections have a design life of 120 months at 100°C

Provide tie bars with rubber top hat washers where working pressure exceeds 4 bar

Supply threaded tie bars with adjustable length

Ensure flexible connections are tied when the plant is on vibration isolation mountings

2650E THREADED END EPDM RUBBER FLEXIBLE CONNECTIONS UP TO 10 BAR AND 70 DEGREE C:

Material - EPDM rubber with wire reinforced cuffs
Synthetic fibre reinforcement within the body
Marking - Mould date of manufacture on bellows
Show manufacturer and type
Ends - Threaded to BS 21 and BS EN 10226-1 with one union end
Operation - Ensure flexible connections have a design life of 120 months at 100°C
Provide tie bars with rubber top hat washers where working pressure exceeds 4 bar
Supply threaded tie bars with adjustable length
Ensure flexible connections are tied when the plant is on vibration isolation mountings

2650F FLANGED FLEXIBLE CHLOROBUTYL RUBBER CONNECTIONS UP TO 10 BAR AND 100 DEGREE C:

Material - Multi-ply reinforced chlorobutyl rubber with wire reinforced cuffs
Synthetic fibre or steel reinforcement within the body
Marking - Mould date of manufacture on bellows
Ends - Flanges to BS EN 1092-1 that can swivel and are removable
Operation - Ensure flexible connections have a design life of 120 months at given conditions
Provide tie bars with rubber top hat washers where working pressure exceeds 4 bar
Supply threaded tie bars with adjustable length
Ensure flexible connections are tied when the plant is on vibration isolation mountings

2650G THREADED END CHLOROBUTYL RUBBER FLEXIBLE CONNECTIONS UP TO 10 BAR AND 100 DEGREE C:

Material - Multi-ply reinforced chlorobutyl rubber with wire reinforced cuffs
Synthetic fibre or steel reinforcement within the body
Marking - Mould date of manufacture on bellows
Show manufacturer and type
Ends - Threaded to BS 21 and BS EN 10226-1 with one union end
Operation - Ensure flexible connections have a design life of 120 months at given conditions
Provide tie bars with rubber top hat washers where working pressure exceeds 4 bar
Supply threaded tie bars with adjustable length
Ensure flexible connections are tied when the plant is on vibration isolation mountings

2650H FLANGED CHLOROBUTYL RUBBER FLEXIBLE CONNECTIONS UP TO 10 BAR AND 60 DEGREE C:

Material - Multi-ply reinforced chlorobutyl rubber with wire reinforced cuffs. Synthetic fibre reinforcement within the body
Marking - Mould date of manufacture on bellows
Show manufacturer and type
Ends - Flanges to BS EN 1092-1 that can swivel and are removable
Operation - Ensure flexible connections have a design life of 120 months at given conditions. Provide tie bars with rubber top hat washers where working pressure exceeds 4 bar

Supply threaded tie bars with adjustable length
Ensure flexible connections are tied when the plant is on vibration isolation mountings

2660A TERMINAL UNIT CONNECTIONS FOR HEATING SERVICES - STAINLESS STEEL:

Material - Stainless steel convoluted hose with stainless steel overbraiding
Carbon steel, stainless steel or copper tube end connections
Fully welded construction
Operation - Ensure hose length is sufficient to prevent the minimum hose bend radius from being exceeded during installation and commissioning
Working pressure 15 - 20 bar and temperature 95°C

2660B TERMINAL UNIT CONNECTIONS WITH QUICK RELEASE COUPLINGS FOR HEATING SERVICES - STAINLESS STEEL:

Material - Stainless steel convoluted hose with stainless steel overbraiding
Carbon steel, stainless steel or copper tube end connections
Fully welded construction
Operation - Ensure hose length is sufficient to prevent the minimum hose bend radius from being exceeded during installation and commissioning
Working pressure 15 - 20 bar and temperature 95°C
Options - Supply quick release couplings with screwed ends
Materials - Male and female nickel plated brass halves each with shut-off valve with rubber seat. Locking mechanism of stainless steel balls and stainless steel internal valve springs

2660D TERMINAL UNIT CONNECTIONS FOR CHILLED WATER SERVICES - STAINLESS STEEL:

Material - Stainless steel convoluted hose with stainless steel overbraiding
Carbon steel, stainless steel or copper tube end connections
Fully welded construction
Nitrile rubber Class 'O' insulation with vapour seal and end protection caps
Operation - Ensure hose length is sufficient to prevent the minimum hose bend radius from being exceeded during installation and commissioning
Working pressure 15 - 20 bar and temperature 95°C

2660E TERMINAL UNIT CONNECTIONS WITH QUICK RELEASE COUPLINGS FOR CHILLED WATER SERVICES - STAINLESS STEEL:

Material - Stainless steel convoluted hose with stainless steel overbraiding
Carbon steel, stainless steel or copper tube end connections
Fully welded construction
Nitrile rubber Class 'O' insulation with vapour seal and end protection caps
Operation - Ensure hose length is sufficient to prevent the minimum hose bend radius from being exceeded during installation and commissioning
Working pressure 15 - 20 bar and temperature 95°C
Options - Supply quick release couplings with screwed ends

Material - Male and female nickel plated brass halves each with shut-off valve with rubber seat

Locking mechanism of stainless steel balls and stainless steel internal valve springs

2670A TEST PLUGS, SELF SEALING:

Provide DZR copper alloy self sealing test plugs for measurement of temperature and pressure, complete with captive cap for sealing when not in use

Ensure test plugs are suitable for system operating temperature and pressure

Provide one thermometer and pressure gauge for each range of conditions, for use with test plugs

2670B TEST PLUGS, VALVE CONTROLLED:

Provide DZR copper alloy self valve controlled test plugs for measurement of temperature and pressure, complete with captive cap for sealing when not in use

Ensure test plugs are suitable for system operating temperature and pressure

Provide one thermometer and pressure gauge for each range of conditions, for use with test plugs

2680A THREADED PIPELINE STRAINERS, BRONZE:

Material - Bronze to BS EN 1982

Ends - Threaded to BS 21 and BS EN 10226-1

Pattern - Y pattern body

Screen free area - Not less than 250% of pipe bore

Screen perforations

15 to 50mm nominal size, within range 0.7 - 0.9 mm diameter

65mm and over nominal size, within range 1.5 - 1.8mm diameter

Internal to external flow through screen

Provide plugged connections for drain, air vent and differential pressure monitoring, threaded to BS 21 and BS EN 10226-1

2680B FLANGED PIPELINE STRAINERS, BRONZE:

Material - Bronze to BS EN 1982

Ends - Flanged to BS EN 1092-3

Pattern - Y pattern body

Screen free area - Not less than 250% of pipe bore

Screen perforations

15 to 50mm nominal size, within range 0.7 - 0.9 mm diameter

65mm and over nominal size, within range 1.5 - 1.8mm diameter

Internal to external flow through screen. Provide plugged connections for drain, air vent and differential pressure monitoring, threaded to BS 21 and BS EN 10226-1

2680D PIPELINE STRAINERS, CAST IRON:

Material - Cast iron

Ends - Flanged to BS EN 1092-2

Pattern - Y pattern body

Screen free area - Not less than 250% of pipe bore

Screen perforations

15 to 50mm nominal size, within range 0.7 - 0.9 mm diameter

65mm and over nominal size, within range 1.5 - 1.8mm diameter

Internal to external flow through screen

Provide plugged connections for drain, air vent and differential pressure monitoring, threaded to BS 21 and BS EN 10226-1

2680E GROOVED END PIPELINE STRAINERS, DUCTILE IRON:

Material - Ductile iron

Ends - Grooved for mechanical joint

Pattern - Y pattern body

Screen free area - Not less than 250% of pipe bore

Screen perforations

15 to 50mm nominal size, within range 0.7 - 0.9 mm diameter

65mm and over nominal size, within range 1.5 - 1.8mm diameter

Internal to external flow through screen

Provide plugged connections for drain, air vent and differential pressure monitoring, threaded to BS 21 and BS EN 10226-1

2690A TUNDISHES, COPPER:

Provide tundishes located adjacent to equipment, as indicated

Use 3mm minimum thickness copper sheet

Form sheet into a tapered reducing cone with a minor diameter to suit drain line

Major diameter nominally 50 mm larger than minor diameter, tapering at approximately 30 degrees

3.15 VALVE LABELS

The sub contractor shall supply and securely attach to all valves, labels which shall identify the valves in accordance with the valve schedules of numbers and operation.

These labels shall be 32mm diameter manufactured from white traffolyte with 15mm high black numbers and shall be suitably fixed to the valves. A comprehensive typed valve schedule shall be included in the operating and maintenance manual.

3.16 TEST POINTS AND GAUGES

Generally each boiler or heat exchanger shall have no less than one temperature and one pressure gauge for efficient control and running. Should an appliance be supplied with such facilities built in, this would generally be acceptable provided the gauges have been correctly calibrated and proved accurate.

Where a range of modular boilers are installed, unless shown on the drawings otherwise, one temperature gauge on the common flow and return headers and one altitude gauge on the return only shall be sufficient.

On multi circuit systems each main branch circuit leaving the plantroom shall be fitted with temperature and pressure gauges on both flow and return pipes.

The main flow and return headers on heating and hot water plant shall also have temperature and pressure gauges fitted.

In order that the installations may be accurately balanced and set to work, binder test points for temperature and pressure tests shall be provided on flow and return connections to all boilers and pumps. Mixing valves and any additional items of equipment that do not have facilities for measurement by commissioning sets shall also have binder test points on both flow and return connections.

Temperature test pockets shall be located and be of sufficient depth as to ensure a true reading of the fluid temperature. Thermometers used shall be of the bi-metal type, pressure and altitude gauges shall be complete with gauge cocks and both shall be as manufactured by 'Brannan Thermometers' or equal and approved.

Except where gauges form part of a packaged unit they shall be no less than 100mm diameter for mounting heights of up to two metres and 150mm diameter above two meters.

All circulating pumps shall have pressure gauges on both suction and delivery connections and shall have binder test points inside the accompanying isolation valves to allow 'closed valve head' to be measured.

Use dial type gauges of robust construction, enclosed in dust tight metal cases. Retain dial glass with bezels screwed to case. Finish with chromium plating.

Use white dial scales indelibly and clearly marked with black lettering to indicate measured values. Select scale ranges which indicate 'Normal' when pointer is vertical or central on scale.

DIRECT MOUNTING:

Dial case - 100mm diameter for direct connection to instrument

Mount gauges with dial face in vertical plane and support casing by connection to instrument.

FLANGE MOUNTING:

Dial case - 100mm diameter with annular mounting flange

Mount gauges with dial face in vertical plane and surface mount casing to equipment or building element, as required

TEMPERATURE GAUGES, GENERAL:

Bimetallic type, mounted direct in pocket to BS EN 13190

Use temperature gauges with pocket and provided with gland attachment on thermometer stem

Use separable type pockets, threaded 15/19mm BSP and manufactured from stainless steel

Screw pockets into tapped bosses or stools set in pipelines or vessels

Fill pockets with oil to BS 7207 to ensure contact with thermometer bulb

Provide gauges with dial graduation in degrees. Celsius marked on a logarithmic scale

Ensure pointer movement is clockwise for increase in temperature

Provide sensing elements for air and gas systems, where indicated, and fix to provide airtight joints

Provide with metal shielding around sensing element to prevent effects of local radiation from equipment.

DIRECT MOUNTING:

Vapour pressure type to BS EN 13190, mounted direct in pocket, with horizontal or vertical stem as appropriate

PRESSURE AND ALTITUDE GAUGES:

Use vapour pressure type gauges to BS EN 837-1. Connect to pipeline systems via matched gauge cocks and cock connectors

Ensure dial graduation is from zero to between 1.5 and 3.0 times normal working pressure

Graduate in bar (gauge) on gauges reading head or working pressure, or in Pascals where pressure differences across plant items are to be established

Where fitted on boilers and pressure vessels, clearly mark with operating and maximum permissible working heads in accordance BS 759

Elsewhere provide gauges with normal working pressure

Ensure dial movement is clockwise for an increasing in head

Fit syphons on steam systems

Provide flexible piping where gauge is subject to noticeable vibration

Fit gauge cocks preceding all connections to altitude and pressure gauges

Copper alloy, tapered ground plug, with ebonite lever

Unless flanged joints are required, screw inlet ends female and fit outlet ends with union connections allowing removal of gauges

3.17 PUMPS

1000 GENERAL

1010 PUMPS:

Provide pumps manufactured and tested in accordance with appropriate British Standard, in particular BS EN 809, BS EN 60335-2-41 and BS EN 60335-2-51 where applicable

1020 PUMP SELECTION:

Select pump at or near most efficient part of performance curve for duty required

1030 SAFETY GUARDS:

Fit safety guards around revolving parts on close coupled and belt drive pumps

1040 PUMP TESTING:

Ensure pumps comply with BS EN ISO 5198 and BS EN ISO 9906 as appropriate

2010A CENTRIFUGAL PUMP - HORIZONTALLY MOUNTED BELT DRIVEN:

Configuration

Casing and motor side by side mounted on bedplate (beltdrive)

Casing:

- Provide casing with drain connection fitted with plug
- Provide threaded connections in accordance with BS 21 and BS EN 10226-1 for drains, vents, water jackets, cooling lines, etc
- Provide pump with split casing to allow access to the impeller for service and maintenance

Impeller:

- Ensure impellers are accurately machined and finished smooth, free from blowholes and other defects and designed to be in dynamic balance at all speeds
- Provide open or semi-open type impellers for removal of sludge or other foreign material to prevent clogging
- Fix impellers to shafts to ensure that they remain firm if direction of rotation is reversed. Indicate direction of rotation on pump casing

Shaft:

- Ensure shaft is of adequate diameter to withstand all imposed loading and has a critical speed when assembled with its impeller at least 10% above normal operating speed

Material:

- Casing - Cast iron to BS EN 1561
- Impeller - Manufacturer's standard Shaft - Stainless steel to BS EN 10088
- Seal Housing - Cast iron to BS EN 1561
- Bearings - Sealed-for-life
- Glands and seals – Mechanical

2010C CENTRIFUGAL PUMP - CLOSE COUPLED:

Configuration

Pump casing and motor mounted on a bedplate in line (close coupled)

Casing:

- Provide casing with drain connection fitted with plug
- Provide threaded connections in accordance with BS 21 and BS EN 10226-1 for drains, vents, water jackets, cooling lines, etc
- Provide pump with split casing to allow access to the impeller for service and maintenance

Impeller:

- Ensure impellers are accurately machined and finished smooth, free from blowholes and other defects and designed to be in dynamic balance at all speeds
- Provide open or semi-open type impellers for removal of sludge or other foreign material to prevent clogging
- Fix impellers to shafts to ensure that they remain firm if direction of rotation is reversed
- Indicate direction of rotation on pump casing

Shaft:

- Ensure shaft is of adequate diameter to withstand all imposed loading and has a critical speed when assembled with its impeller at least 10% above normal operating speed

Material:

- Casing - Cast iron to BS EN 1561
- Impeller - Manufacturer's standard
- Shaft - Manufacturer's standard
- Seal Housing - Cast iron to BS EN 1561
- Bearings - Sleeve
- Glands and seals – Mechanical

2010D CENTRIFUGAL PUMP - DIRECT DRIVE IN-LINE:**Configuration:**

- Direct driven unit with pump body incorporating inlet and outlet connections in line, to allow pump to be mounted in pipework

Casing:

- Provide casing with drain connection fitted with plug
- Provide threaded connections in accordance with BS 21 and BS EN 10226-1 for drains, vents, water jackets, cooling lines, etc
- Provide pump with split casing to allow access to the impeller for service and maintenance

Impeller:

- Ensure impellers are accurately machined and finished smooth, free from blowholes and other defects and designed to be in dynamic balance at all speeds
- Provide open or semi-open type impellers for removal of sludge or other foreign material to prevent clogging
- Fix impellers to shafts to ensure that they remain firm if direction of rotation is reversed
- Indicate direction of rotation on pump casing

Shaft

- Ensure shaft is of adequate diameter to withstand all imposed loading and has a critical speed when assembled with its impeller at least 10% above normal operating speed

Material:

- Casing - Cast iron to BS EN 1561
- Impeller - Manufacturer's standard
- Shaft - Stainless steel to BS EN 10088
- Seal Housing - Cast iron to BS EN 1561

Bearings:

- Sealed-for-life or pre-packed type requiring no maintenance (in-line pumps)
- Glands and seals - Mechanical

2010E**CENTRIFUGAL PUMP - DIRECT DRIVE, IMMERSED ROTOR:****Configuration:**

- Sealed unit with immersed rotor with pump body incorporating inlet and outlet connections in line, to allow pump to be mounted in pipework

Casing:

- Provide casing with drain connection fitted with plug
- Provide threaded connections in accordance with BS 21 and BS EN 10226-1 for drains, vents, water jackets, cooling lines, etc
- Provide pump with split casing to allow access to the impeller for service and maintenance

Impeller:

- Ensure impellers are accurately machined and finished smooth, free from blowholes and other defects and designed to be in dynamic balance at all speeds
- Provide open or semi-open type impellers for removal of sludge or other foreign material to prevent clogging
- Fix impellers to shafts to ensure that they remain firm if direction of rotation is reversed. Indicate direction of rotation on pump casing

Shaft:

- Ensure shaft is of adequate diameter to withstand all imposed loading and has a critical speed when assembled with its impeller at least 10% above normal operating speed

Material:

- Casing - Cast iron to BS EN 1561, or cast gunmetal to BS EN 1982
- Impeller - Manufacturer's standard
- Shaft - Stainless steel to BS EN 10088
- Seal Housing - Manufacturer's standard

Bearings:

- Sealed-for-life or pre-packed type requiring no maintenance (in-line pumps)
- Glands and seals - Manufacturer's standard

4010 GENERAL:

Comply with manufacturer's recommendations for installation of pumps

For in-line pumps ensure that motor is positioned in accordance with manufacturer's requirements

4020 PIPELINE CONNECTIONS:

Support pumps independently from connecting pipework to ensure no load is transmitted from pipework to pump casing on pump suction and discharge

4040 ALIGNMENT:

Align pump to prevent undue restraint and thrust on interconnecting pipework

Align drives to prevent undue wear and restraint on pump shaft

For belt drives, align pulleys and tension belts to prevent undue wear and out of balance forces

4050 ACCESS:

Locate pump within the system with adequate space around it for service and maintenance

3.18 WATER TANKS / CISTERNS

1000 GENERAL

1010 TANK DESIGN:

Design and fabricate tanks/cisterns in accordance with British Standards

1020 DOMESTIC STORAGE WATER CISTERNS:

Ensure storage cisterns for domestic water purposes comply with the Water Supply (Water Fittings) Regulations 1999 and amendment

2020A SECTIONAL A1 GLASS FIBRE REINFORCED SECTIONAL TANK TO BS EN 13280:

Class A1 - for potable water incorporating screened air inlet, vent pipe entry device for the cover, screened warning and overflow pipes and particle ingress limitation between a one-piece cistern or sectional tank, cover and fittings

Sectional tanks - External flanges

4010 GENERAL:

Store, handle and erect all in accordance with manufacturer's recommendations and relevant British Standards

Make due allowance for valves, fittings, access, etc., to accommodate insulation and weathering where indicated

4020 PROTECTION AND CLEANING:

Ensure adequate protection from damage and ingress of foreign matter to tanks and cisterns during storage, erection and commissioning

Thoroughly clean out all tanks and cisterns prior to site testing and commissioning

4030 INSPECTION AND ACCESS:

Install tanks and cisterns to allow internal and external surfaces to be easily inspected and cleaned

3.19 HEAT EXCHANGERS

1000 GENERAL

1010 HEAT EXCHANGER DESIGN:

Supply heat exchangers designed in accordance with British Standards

4010 GENERAL:

Store, handle and erect all equipment in accordance with manufacturer's recommendations and relevant British Standards

Make due allowance for valves, fittings, access etc., to accommodate insulation where specified

Support equipment such that all component parts, connections or insulation have clearance from supports

4030 PROTECTION AND CLEANING:

Provide protection from damage and ingress of foreign matter to heat exchangers and condense coolers during storage, installation and testing

4040 INSPECTION:

Install heat exchangers and condense coolers such that internal and external surfaces can be readily inspected and cleaned

4050 RUST PROTECTION:

Ensure heat exchanger and condense cooler shells are completely free of rust and corrosion and coated with factory applied primer

3.20 TRACE HEATING

1000 GENERAL

Comply with BS 7671 (IET Wiring Regulations) and BS 6351, BS EN 62395-1

2010C ELECTRIC TRACE HEATING, SELF REGULATING TAPE, RCD PROTECTION:

Supply electric trace heating complete with fixing tape, shrink sleeves, crimps, junction boxes and controls

Tape - Self regulating heating tape

Insulation

Thermoplastic elastomer or modified polyolefin

Jacket - Tinned copper braid

Electrical protection - Provide MCB and RCD protection

3010 INSTALLATION OF ELECTRIC TRACE HEATING:

Install electric surface heating in accordance with BS 6351-3 and manufacturer's instructions

Ensure pipe is cleaned of all abrasive material prior to application

3040 THERMAL INSULATION:

Enclose pipework to be heated and trace heating elements in common thermal insulation

Use oversized insulation

3.21 DUCTWORK SERVICES – GENERAL

The sub contractor shall include for keeping on site one copy of DW144 which shall be freely open for reference purposes to the sub contractor, his sub contractors, the Architect, Consulting Engineer and Main contractor as and when any situation demands.

The sub contractor shall include for taking site dimensions and preparing ductwork fabrication drawings. Copies of the fabrication drawings shall be submitted to the Consulting Engineer for approval prior to any work commencing on site.

The sub contractor shall be entirely responsible for any specialist contractor employed by him for the manufacture and erection of the ductwork installation. The specialist contractor shall be subject to the approval of the Consulting Engineer.

The manufacture and erection of all ductwork shall be to a high standard of construction and quality. Any unsatisfactory or poor work shall not be accepted and shall be replaced at no extra cost to the project and without delay to the contract programme.

1000 GENERAL**1010 DUCTWORK INSTALLATION STANDARDS:**

Carry out construction and installation of ductwork in accordance with DW 144, DW 154, DW 172, DW 191 and BS 9999, BS EN 1507, BS EN 12237, BS EN 13403 as appropriate

1020 DUCTWORK DIMENSIONS:

Sizes of ductwork are internal dimensions

Where applicable make allowance for any internal lining

1030 ELECTRICAL BONDING TERMINAL:

Ensure an electrical bonding terminal is provided suitable for connection of a main protective conductor complying with BS 7671, clause 544.1

2010A DESIGN INFORMATION - CLASS A POSITIVE:

Supply ductwork in accordance with classification in DW 144 Table 1 and DW 154 Table 1, BS EN 1507 Table 1 and BS EN 12237 Table 2

Ductwork Classification and Air Leakage limits Low pressure - Class A - Positive

2010B DESIGN INFORMATION - CLASS A NEGATIVE:

Supply ductwork in accordance with classification in DW 144 Table 1 and DW 154 Table 1, BS EN 1507 Table 1 and BS EN 12237 Table 2

Ductwork Classification and Air Leakage limits Low pressure - Class A – Negative

2010D DESIGN INFORMATION - CLASS B NEGATIVE:

Supply ductwork in accordance with classification in DW 144 Table 1 and DW 154 Table 1, BS EN 1507 Table 1 and BS EN 12237 Table 2

Ductwork Classification and Air Leakage limits Medium pressure - Class B – Negative

2020 A SPECIAL INSTALLATIONS:

Details of special installations, as DW 144, Part Two - Standards paragraph 5.2

Polluted air or exceptional conditions

Ductwork exposed to a hostile environment Environmental conditions for plastics ductwork

2025 SPARK TESTING ON PLASTICS DUCTWORK:

Carry out spark testing in accordance with DW 154 at land marks identified in the contract programme

2030B MEDIUM PRESSURE DUCTWORK AIR LEAKAGE TESTING:

Test medium pressure ductwork in accordance with DW 144, A5

Test indicated sections of duct system for air leakage

Test at the pressure recommended in DW 144 Table 17 for the classification of the selected ductwork

Carry out the tests as the work proceeds and prior to application of thermal insulation

If the test fails, pressure test two further sections as indicated

If the further tests fail, apply remedial action to the complete ductwork system

Provide documented evidence of the calculations used to arrive at the allowable loss for the section to be tested and ensure the client or his agent witnesses and signs the results of the tests

Testing plant items, DW 144, Part 8, A.8

2035 STRENGTH AND LEAKAGE TESTING OF CIRCULAR SHEET METAL DUCTWORK:

Carry out ductwork strength and air leakage testing on circular sheet metal ductwork in accordance with BS EN 12237

Test procedure shall be as detailed in BS EN 12237, Section 7

Produce a test report as detailed in BS EN 12237, Section 8

2036 STRENGTH AND LEAKAGE TESTING OF RECTANGULAR SHEET METAL DUCTWORK:

Carry out ductwork strength and air leakage testing on circular sheet metal ductwork in accordance with BS EN 15727

Test procedure shall be detailed in BS EN 15727

Produce a test report as detailed in BS EN 15727

2070 MAN ACCESS AND SAFETY BARS:

Man access is required where indicated on drawings

Ensure that duct floor is of sufficient strength to comply with safety standards

Provide safety bars where indicated at the top of risers

2100A RECTANGULAR PVC-U PLASTICS DUCTWORK TO DW 154:

Manufacture and install plastic ductwork in accordance with DW 154

Material - PVC-U (Unplasticized polyvinyl chloride)

Construction - Rectangular ducts DW 154 Part 3

Provide internal stiffeners

2100G CIRCULAR PVC-U PLASTICS DUCTWORK TO DW 154:

Manufacture and install plastic ductwork in accordance with DW 154

Material - PVC-U (Unplasticized polyvinyl chloride)

Construction - Circular ducts DW 154 Part 4

2120A INTERNAL THERMAL/ACOUSTIC INSULATION:

Fit internal linings at works in accordance with DW 144 paragraphs 29.2 and 29.4

2130B PRE-INSULATED ALUMINIUM DUCTWORK:

External aluminium - Thickness 8mm

Finish - Embossed, protected with polyester lacquer Internal aluminium - Thickness 8mm

Finish - Embossed, protected with polyester lacquer Insulation - 20mm polyurethane

2140A HANGERS AND SUPPORTS:

Provide hangers and supports throughout in accordance with DW 144 Part Six Section 19; DW 154 Part 5; or DW 191 Section 7 as appropriate

Comply with BS EN 12236

2150A SUPPORT OF AIR TERMINAL UNITS:

Support air terminal units and their plenums by the structural soffit support from the ceiling grid not permitted

3010 CONSTRUCTION AND FINISHES:

Ensure that materials of accessories are compatible with ductwork and that finishes of accessories comply with any special requirements for ductwork

Ensure casing losses of components are compatible with ductwork in which they are incorporated

3020A METAL DUCTWORK INSPECTION/SERVICING ACCESS OPENINGS:

Provide access/inspection openings in accordance with DW 144 Part Seven Section 20 and Appendix M Table 25 Level 1

3020C PLASTIC DUCTWORK INSPECTION/SERVICING ACCESS OPENINGS:

Provide access openings in accordance with DW 154 Part 6, Section 15 and Appendix D, Table 14

3020D DUCTWORK INSPECTION/SERVICING ACCESS OPENINGS:

Provide access/inspection openings in accordance with HVCA TR/19, Section 3

3030A METAL DUCTWORK TEST HOLES:

Provide test holes in ductwork system, as shown on drawings, to allow complete testing and balancing of system in accordance with CIBSE Commissioning Code A

Site drill test holes in accordance with DW 144 paragraph 20.6

3040 HOLES FOR CONTROLS/INSTRUMENTS - METAL DUCTWORK:

Provide holes in ductwork, in accordance with DW 144 Part Seven, paragraph 20.7, to accommodate thermostats, humidistats and other control sensors in positions and sizes indicated on drawings

3042 INSTALLATION OF INSTRUMENTS AND CONTROLS:

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

3050A CLEANING ACCESS - LEVEL 2:

Provide access for cleaning in accordance with DW 144 Part Seven, paragraph 20.8 and Appendix M Table 25 Level 2

3050B CLEANING ACCESS - LEVEL 3:

Provide access for cleaning in accordance with DW 144 Part Seven, paragraph 20.8 and Appendix M Table 25 Level 3

3050C CLEANING ACCESS - HVCA TR/19:

Provide access/inspection openings in accordance with HVCA TR/19, Section 3

3060B STEEL MULTI-BLADE BALANCING DAMPERS - METAL DUCTS:

Provide single or double skin steel multi-blade balancing dampers in accordance with DW 144 Part Seven Section 21

Parallel or opposed blade, manual operation

Locations and size as shown on drawings

3060D STEEL MULTI-BLADE CONTROL DAMPERS - METAL DUCTS:

Provide single or double skin steel multi-blade control dampers in accordance with DW 144 Part Seven Section 21

Parallel or opposed blade, automatic operation

Locations and size as shown on drawings

3060F STEEL BACK DRAUGHT REGULATING DAMPERS - METAL DUCTS:

Provide regulating dampers in accordance with DW 144 Part Seven Section 21

Locations and size as shown on drawings

3061A SINGLE BLADE BALANCING DAMPERS - PLASTICS DUCTWORK:

Provide single blade balancing dampers in accordance with DW 154 Part 6 Section 16

Locations and size as shown on drawing

3061B MULTI-BLADE BALANCING DAMPERS - PLASTICS DUCTWORK:

Provide multi-blade balancing dampers in accordance with DW 154 Part 6 Section 16

Locations and size as shown on drawing

3061C SINGLE BLADE CONTROL DAMPERS - PLASTICS DUCTWORK:

Provide single blade control dampers in accordance with DW 154 Part 6 Section 16

Locations and size as shown on drawing

3061D MULTI-BLADE CONTROL DAMPERS - PLASTICS DUCTWORK:

Provide multi-blade control dampers in accordance with DW 154 Part 6 Section 16

Locations and size as shown on drawing

3070C STEEL CURTAIN FIRE DAMPERS - BLADES OUT OF AIR STREAM:

Supply and install steel folding curtain fire dampers, with blades out of the air stream in accordance with DW 144 Part Seven Section 22, size and location as shown on the drawings

3070I INTUMESCENT FIRE DAMPERS:

Supply and install intumescent fire dampers in accordance with DW 144 Part Seven Section 22, size and location as shown on the drawings

Fire resistance tests for intumescent dampers shall be in accordance with BS ISO 10294-5

3070J FIRE DAMPERS ACCESSORIES:

Provide accessories compatible with fire dampers

Electrical cut-out switches and external visual indication of fire damper blade position

Supply spare fusible links for fire dampers to fuse at 72°C as specified in DW 144

3075 FIRE DAMPERS - GENERAL:

Provide fire dampers generally in accordance with DW 144 Section 22 and DW 154 Part 6 paragraph 17 and DW145. Types to be as identified elsewhere in the specification, in schedules or on drawings

Fire dampers shall be supplied and fixed in accordance with the manufacturer's recommendations and installation methods which conform to the prevailing Building Regulations (ADB) and are acceptable to the District Surveyor/Building Control Officer and Fire Officer generally in accordance with DW 145. The proposed installation method must be supported by a valid test report or assessment provided by an approved third party notified body

The construction shall allow for all additional framing supports, bracing and fire stopping as may be necessary to adequately attach/install the fire dampers to the structure. The assembly is to be approved by the Building Control Officer/District Surveyor and Fire Officer

Each fire damper and associated installation method shall have at least the same standard of fire integrity as the wall or floor through which the duct passes

The classification of fire dampers is to be in accordance with BS EN 13501-3 and shall have an integrity classification 'E' to meet that of the wall or floor

When a fire integrity of 4 hours is required, either two dampers (classified E120) factory assembled in series (if acceptable to the local authority) or a single damper having a classification E240, may be used

To achieve these classifications, fire resistance tests shall be in accordance with BS EN 1366-2, undertaken by a notified body

Shutter dampers shall be provided with the shutter blades located outside the air stream (unless other wise indicated). Each damper shall have a stainless steel curtain in all-welded galvanized steel casing with stainless steel side seal gaskets. The damper blade curtain shall be held in the folded position by a dual safe thermal actuator and fusible link

All damper blades shall be tensioned to ensure instantaneous closure on thermal activation at 72°C (unless specified elsewhere). A self-latching reset mechanism shall be provided for easy re-setting of the damper curtain

On completion of the installation, the contractor shall be responsible for ensuring the inspection and testing of all fire dampers installed are carried out. Upon completion of the tests, the certificates must be issued for confirming that the dampers have been inspected and that they function correctly in accordance with the manufacturer's data sheets

Access panels with chains shall be provided adjacent to the access side of all fire dampers. In no instances shall flexible duct connections be allowed onto fire dampers through walls or floors. Approved flexible connectors for breakaway joints, or duct expansion in case of fire, may be used in association with fire dampers

Provide local external visual indication of fire damper blade position, unless indicated otherwise

3079 SMOKE DAMPERS – GENERAL:

Provide smoke dampers generally in accordance with DW 144 Part 7, Section 23

Types to be as identified elsewhere in the specification, in schedules or on drawings

Smoke dampers shall be supplied and fixed in accordance with the manufacturer's recommendations and installation methods with installation mounting frames which conform to the prevailing Building Regulations (ADB) and are acceptable to the District Surveyor/Building Control Officer and Fire Officer and are generally in accordance with DW 144

The proposed installation method must be supported by a valid test report or assessment provided by an approved third party notified body

The construction shall allow for all additional framing supports, bracing and fire stopping as may be necessary to adequately attach/install the smoke dampers to the structure.

The assembly is to be approved by the Building Control Officer/District Surveyor and Fire Officer.

The classification of smoke dampers is to be in accordance with the requirements of BS EN 13501-3.

Smoke dampers shall be of the single blade or multi-blade type as indicated elsewhere in this specification. Damper blades shall be mechanically connected to an actuator to hold the blades in either the open or closed position dependant on the control mode chosen.

On completion of the installation, the contractor shall be responsible for ensuring the inspection and testing of all smoke dampers installed are carried out. Upon completion of the tests, the certificates must be issued for conforming that the dampers have been inspected and that they function correctly in accordance with the manufacturer's data sheets.

Access panels with chains shall be provided adjacent to the access side of all smoke dampers (additional access may be required for cleaning purposes and should be supplied if necessary).

In no instances shall flexible duct connections be allowed through walls or floors. Approved flexible connectors fro breakaway joints, or duct expansion in case of fire, may be used in association with smoke dampers.

Provide local external visual indication of smoke damper blade position, unless indicated otherwise.

3080A STEEL SINGLE BLADE SMOKE DAMPERS:

Supply and install steel single blade dampers in accordance with DW 144 Part 7, Section 23, size and location as shown on the drawings

3080B STEEL MULTI-BLADE SMOKE DAMPERS:

Supply and install steel multi-blade smoke dampers in accordance with DW 144 Part 7, Section 23, size and location as shown on the drawings

3100A COATED STEEL FLEXIBLE DUCTS:

Supply and fasten coated steel flexible duct connections as DW 144 Part Seven Section 25
Use flexible duct connections in applications listed in DW 144 paragraph 25.1
Comply with BS EN 13180. Maximum length 500mm

3100B ALUMINIUM FLEXIBLE DUCTS:

Supply and fasten aluminium flexible duct connections as DW 144 Part Seven Section 25
Use flexible duct connections in applications listed in DW 144 paragraph 25.1
Comply with BS EN 13180. Maximum length 500mm

3100C PVC/POLYESTER LAMINATE FLEXIBLE DUCTS:

Supply and fasten PVC/polyester laminate flexible duct connections as DW 144 Part Seven Section 25
Use flexible duct connections in applications listed in DW 144 paragraph 25.1
Comply with BS EN 13180. Maximum length 500mm

3100D ALUMINIUM/POLYESTER FLEXIBLE DUCTS:

Supply and fasten flexible duct connections as DW 144 Part Seven Section 25
Use flexible duct connections in applications listed in DW 144 paragraph 25.1
Material - Aluminium/Polyester laminate encapsulating high tensile steel wire helix
Comply with BS EN 13180. Maximum length 500mm

3110A FLEXIBLE JOINT CONNECTIONS:

Supply and install flexible joint connections as detailed in DW 144 Section 26 or DW 154 Section 18, as appropriate

Use flexible joints, as shown on drawings; on fan inlet/outlets; and on building expansion joints. Comply with BS 476-24

3120A BIRD WIRE GUARDS:

Fit bird screens of 13mm square mesh wire on all intake and extract louvres to atmosphere

Wire gauge to be not less than 1mm

Finish - Plastic coated wire

4010 GENERAL WORKMANSHIP:

Install ductwork in accordance with DW 144, DW145, DW 154 and DW 191 as appropriate

Ensure that there are no sharp edges or corners on cut edges on ductwork, flanges and supports

Install pre-insulated ductwork to BS EN 13403 in accordance with manufacturer's instructions

4020 DUCTWORK SUPPORTS:

Support ductwork in accordance with DW 144 Part Six Section 19; DW 154 Part 5; or DW 191 Section 7 as appropriate

Install supports to ensure insulation can be applied unless otherwise indicated

4025 COMPONENT SUPPORT ON PRE-INSULATED ALUMINIUM DUCTWORK:

Support ducts with dimensions less than 1m at intervals of no more than 4m

Support ducts with dimensions over 1m at intervals of no more than 2m

Provide independent support for all accessories

4030A DUCT SUPPORT FOR VAPOUR SEAL CONTINUITY:

Where a vapour seal is required, use method of support detailed on drawing as indicated

4040 EXTERNAL DUCTWORK SUPPORT:

Support ductwork external to building as indicated

4050 DUCTWORK FLOOR SUPPORT:

Support ductwork from floor as indicated

4060 DRAINAGE OF DUCTWORK:

Arrange ductwork to drain any entrained moisture and ensure the lapping of joints minimises moisture leakage

4090A INTERNAL CLEANLINESS - LEVEL 1:

Provide Level 1 of protection, delivery and installation (PDI) as defined in HVCA TR/19, Section 2

4090B INTERNAL CLEANLINESS - LEVEL 2:

Provide Level 2 of protection, delivery and installation as defined in HVCA TR/19, Section 2

4090D DRY METHOD OF CLEANING:

Method of cleaning in accordance with HVCA TR/19, Table 6

4090E WET METHOD OF CLEANING:

Method of cleaning in accordance with HVCA TR/19, table 7

The system should be thoroughly dried prior to commissioning/de-commissioning to prevent moisture assisting in the growth of micro-organisms

A risk assessment must be carried out before any cleaning chemicals or biocides are considered. The details of any such chemicals or biocides must be recorded and any adverse effects of the applied chemicals assessed and determined, with appropriate safe procedures set out in a formal method statement

Steam cleaning and high pressure waterwash are not recommended for ductwork that is situated above ceilings or in sensitive areas unless carried out in a controlled manner to contain leakage. Procedures to take account of operative safety must be adopted, and should be set out in written form

Careful consideration should be given to the use of chemicals and/or water for surfaces that are porous e.g. internally-lined ductwork, attenuators, fibre board ductwork, attenuators, fibre board ductwork etc., to prevent permanent damage

Before applying wet cleaning methods care should be taken that condensed vapours and cleaning fluids can be removed from the ductwork system

4100A WEATHERPROOFING:

Fit ductwork with trimming angle and weather cravat, skirt, flashing plate and cowl where ductwork passes through or terminates in roof, to ensure a weatherproof seal to building structure, as indicated

4110A DUCTWORK SLEEVES:

Where indicated, enclose ducts passing through building elements, (walls, floors, partitions, etc.) within purpose made sleeves

Cut sleeves of the same material as the duct and pack with mineral fibre or similar non-flammable and fire resistant material to form a fire/smoke stop of adequate rating and to prevent air movement and noise transmission between duct and sleeve

Where finished insulation is carried through duct sleeves. Pack space between insulation finish and sleeve with non-flammable and fire resistant material to form fire stop

4110B DUCTWORK SLEEVES WITH FLANGES:

Where indicated, enclose ducts passing through building elements, (walls, floors, partitions, etc.) within purpose made sleeves. Cut sleeves of the same material as the duct and pack with mineral fibre or similar non-flammable and fire resistant material to form a fire/smoke stop of adequate rating and to prevent air movement and noise transmission between duct and sleeve

Provide flanges on either side of wall where ductwork is exposed in rooms

Where finished insulation is carried through duct sleeves. Pack space between insulation finish and sleeve with non-flammable and fire resistant material to form fire stop

4130 INSTALLATION OF CONTROL EQUIPMENT:

Fit sensors, damper motors and other control equipment as indicated

All control equipment should be installed to manufacturer or specialist supplier's requirements

The installation must be checked by the manufacturer or specialist supplier, and rectified as necessary

4140 INSTRUMENT CONNECTIONS:

Provide instrument connections where indicated

All instrument connections should be installed to manufacturer or specialist supplier's requirements

The installation must be checked by the manufacturer or specialist supplier, and rectified as necessary

4160 DAMPER ACCESS:

Ensure access is provided to damper mechanisms on fire dampers; smoke dampers; combined smoke and fire dampers; and volume control dampers through access doors, false ceilings etc

Demonstrate that damper blades close completely

Demonstrate that fire links can be replaced. Where more than one fire damper is installed in a frame ensure access is provided to all fire dampers

3.22 AHU'S

1000 GENERAL

1010A AIR LEAKAGE:

Ensure air handling unit is sealed to prevent air leakage at design pressure

Determine air leakage in accordance with HEVAC Guide to Air Handling Unit Leakage Testing, figure 3 at 400 Pa negative pressure

1010B AIR LEAKAGE:

Ensure air handling unit is sealed to prevent air leakage at design pressure

Determine air leakage in accordance with BS EN 1886, table 2 at 400 Pa negative pressure and table 3 at 700 Pa positive pressure

1010C AIR LEAKAGE - FILTER BYPASS:

Determine air bypass around filter cells in accordance with BS EN 1886

Ensure air leakage rates do not exceed the values given in table 4 of BS EN 1886 at a test pressure of 400 Pa

2020A PLASTIC COATED STEEL DOUBLE SKIN CASING AIR HANDLING UNITS:

Outer skin material - plastic coated steel

Inner skin material - zinc coated steel hot dip galvanized to BS EN 10327 or BS EN 10143

External casing finish - self finish

Internal casing finish - self finish

2020B MANUFACTURER'S STANDARD DOUBLE SKIN CASING AIR HANDLING UNITS:

Outer skin material - Manufacturer's standard

Inner skin material - Manufacturer's standard

External casing finish - Manufacturer's standard

Internal casing finish - Manufacturer's standard

2030A AIR HANDLING UNIT CONSTRUCTION:

General construction

Construct unit to withstand maximum fan static pressure without plastic deformation

Ensure panels do not deflect by more than 1/120 of maximum panel dimension when unit is in operation

Use corrosion resistant fastenings throughout

Do not use self tapping screws

Provide panel gaskets to give a durable seal between panels and frames to prevent excessive air leakage

Construct unit to avoid thermal bridging. Provide stacking units where indicated

Casing thermal performance:

- Ensure the casing thermal performance is tested in accordance with the requirements of BS EN 1886

Casing Insulation:

- Ensure insulation complies with BS 476-7. Ensure insulation is fixed securely to panel, and protected to prevent migration of fibre into air flow

Insulation to provide thermal, structural or acoustic treatment as indicated

Ensure insulation is vapour sealed throughout and incorporate thermal breaks

Insulation material

Provide insulation that is inorganic, vermin proof and non-hygroscopic

Use mineral fibre, minimum of 50mm thick, or CFC free rigid polyurethane foam, minimum of 25 mm thick or CFC free injected polyurethane foam, minimum 25 mm thick

Framework:

- Ensure framework is rigid enough to prevent distortion during transportation and after final assembly on site

Seat panels into folded, rolled or extruded frame with purpose made corner joints; or pentapost type frame with purpose made corner joints

Ensure framework is self supporting. For vertical units strengthen framework to support additional weight

Base:

- Provide feet under each section; formed base; or RSC base

2040A AIR HANDLING UNIT ACCESS:

Provide access openings and covers complete with opening devices, and sealed to prevent air leakage

Ensure seals are designed for normal maintenance operations for a minimum of 10 years

Provide hinged access doors, 400mm minimum width

Operating device - key operated door locks

Provide access to fans, dampers, filters, spray coils, humidifiers and within air handling unit for inspection of nozzles and tanks

3010A FAN SECTION:

Provide frame for motor and fan and comply with fire regulations

Ensure frame is isolated from casing

For blow through units ensure air flow in downstream sections of unit has relatively uniform velocity profile

Supply fan guards to BS EN ISO 12100

Accessories:

- Provide flexible connection between fan discharge and casing spigot
- Ensure flexible connections comply with fire regulations
- Provide manometer connections to measure static pressure at fan inlet eye
- Provide manometer connections to measure static pressure at fan discharge

3030 HEATER BATTERIES:

Provide slide rails to allow each coil section to be removed independently for access

Fit baffle plates to prevent air bypass of coil

3040 COOLING COIL SECTION:

Provide slide rails to allow each coil section to be removed independently for access

3050A DRAINAGE FROM AIR HANDLING UNIT COMPONENTS:

Provide drainage pipework from cooling coils, humidifiers and components where water may collect

Comply with recommendations in CIBSE technical memorandum TM13 in connection with Legionnaires' disease

Material - Glass drainage system

3060A CONTROL DAMPERS:

Provide manufacturer's standard control dampers in accordance with DW 144 part 7 section 21

Provide motorized control dampers complete with extended spindle; motor; motor linkage; and motor support

4040 DUCT CONNECTIONS:

Ensure air is straightened as it leaves unit discharge. Ensure ductwork connection is long enough to ensure the aerodynamic performance of the fan is not affected

4050 SERVICES CONNECTIONS:

Ensure panels are sealed around electrical cable and pipework service entry points to prevent air leakage, using suitable and approved methods to suit individual services applications

Provide flexible cables between fan motor and local isolator

4060 ISOLATION OF UNITS:

Provide means of isolating air handling units electrically to allow maintenance and repairs to be carried out

Provide means of isolating pipework to air handling units to allow maintenance and repairs to be carried out

Provide means of isolating steam to humidifier when access door is opened

3.23 FANS

1000 GENERAL

1010 DESIGN DUTIES:

Air Volume

Ensure scheduled volume is provided when operating against resistance of system corrected for changes between specified and selected component resistances

System Resistance:

- Adjust scheduled resistance to compensate for actual resistance of selected components

Operating Point:

- Select operating point on pressure/volume curve to provide stable and efficient operation

Guaranteed Performance:

- Provide fan performance figures in accordance with BS 848-1, BS 848-9

1020 PROTECTION:

Protect casings, impellers and shafts against corrosion

Protect bearings against dirt and moisture

2010A NORMAL OPERATING CONDITIONS WITH CIBSE NOISE REQUIREMENTS:**Sound Power Level**

Select fan, motor, drive and speed control system not to exceed typical fan noise level spectra as given in CIBSE guide

Provide sound power data in accordance with BS EN ISO 5136, BS ISO 13347-1, BS ISO 13347-2, BS ISO 13347-3, BS ISO 13347-4

Air Density:

- Relate fan performance to air density 1.20kg/m³

Temperature Range:

- Minimum to maximum operating temperatures -50°C to 30°C

2010B POTENTIALLY EXPLOSIVE ATMOSPHERES:**Constructional requirements**

The constructional requirements for fans constructed to Group IIG (of explosion groups IIA, IIB and hydrogen) categories 1, 2 and 3, and Group IID categories 2 and 3, intended for use in explosive atmospheres shall be in accordance with BS EN 14986 and BS EN 13463-1

Ambient atmosphere pressure:

Absolute pressure ranging from 0.8bar to 1.1bar

Temperature range:

Minimum to maximum operating temperatures of -200°C to 600°C inlet gas temperature, -10% to +20% of nominal gas flow

2020A CONSTRUCTION AND HANDLING:**Casings:**

- Construct rigid casing free from drumming under operating conditions. Supply in sections as required for access or handling. Flange dimensions in accordance with BS 848-4
- Safety standards - to BS EN 60335-2-80

Rotating assemblies:

- Balance in accordance with BS ISO 1940-1; BS ISO 11342; or BS 7854-1; as appropriate.

Shafts and hubs:

- Machine impeller bosses and shafts to BS 4500 and key in accordance with BS 4235-1
- Hold impeller to shaft with set screw or taper lock fitting
- Shaft bearings - sealed for life

Drives and guards:

- Provide guards over shaft, couplings and rope in accordance with BS EN ISO 12100 and Factory Inspectorate requirements
- Material - galvanized or sheet steel

Lifting:

- Provide lifting eyebolts or similar facilities on fans or sections heavier than 20kg

2030 TESTING:

Provide results of aerodynamic performance tests in accordance with BS ISO 14695

2040A VARIABLE AIR VOLUME FANS METHODS:

Centrifugal fan:

- With inlet guide vanes
- With inlet guide vanes complete with actuator
- With variable speed drive

Axial fan:

- With variable speed drive
- With variable pitch blades
- With variable pitch blades complete with actuator

Mixed flow fan:

- With flow control complete with actuator
- With flow control
- With variable speed drive

2060A MOTOR AND DRIVE:

Speed:

- Single speed
- Variable speed
- Two speed
- Standards - adjustable speed electrical power drive
- Safety requirements as BS EN 61800-5-1

Options:

- Motor out of air stream
- Suitable for inverter control
- When fan is handling saturated or corrosive air, provide motor ventilation to clean air

Drive:

- Direct
- Belt driven

2070B BIFURCATED AXIAL FLOW FANS:

Aerodynamic efficiency not less than seventy per cent

Bearings:

- Provide bearings suitable for mounting and direction of flow

- Casing - bifurcated unit

2080A CENTRIFUGAL FANS:

Aerodynamic efficiency:

- Backward curved type, not less than 75%
- Forward curved type, not less than 65%

Operation:

- Single
- Twin fan with changeover

Impeller Design

Supply fan with impeller:

- to suit operating conditions
- high speed, backward curve
- laminar, backward curve
- true aerofoil section - hollow blades
- slow speed, forward curve.
- multi blade - braced steel plate
- multi blade - sheet steel
- radial bladed for dust extraction

Bearings:

Casing:

- Single inlet single width
- Double inlet double width

Mounting:

- Channel frame
- Cast iron bed frame

Drain - Fit drain connection at lowest point of scroll

2080A SINGLE INLET SINGLE WIDTH CENTRIFUGAL FANS:

Aerodynamic efficiency:

- Backward curved type, not less than 75%
- Forward curved type, not less than 65%

Operation - single

Impeller Design:

Supply fan with impeller to suit operating conditions

Casing - single inlet single width

Mounting - channel frame

Drain:

Fit drain connection at lowest point of scroll unless indicated otherwise

2080C DOUBLE INLET DOUBLE WIDTH CENTRIFUGAL FANS:

Aerodynamic efficiency:

- Backward curved type, not less than 75%
- Forward curved type, not less than 65%

Operation - single

Impeller Design

Supply fan with impeller to suit operating conditions

Casing - double inlet double width

Mounting - channel frame

Drain

Fit drain connection at lowest point of scroll unless indicated otherwise

2110A ROOF MOUNTED SINGLE FANS:

Operation - single

Vertical or horizontal discharge as shown on drawings

2110B ROOF MOUNTED TWIN FANS:

Operation - twin with automatic changeover

Vertical or horizontal discharge as shown on drawings

3020 INSPECTION DOORS - CENTRIFUGAL FANS:

Fit air-tight doors in scroll and cover

3050A GUARDS:

Provide guards in accordance with BS EN ISO 12100

Fit safety guards on air inlet and air outlet connections where these are freely accessible to personnel in accordance with BS 848-5

Provide bird guards where indicated

3110 AIR FLOW SENSORS:

Fit air flow sensors or pressure switches on twin fan units to sense fan failure and provide automatic changeover to standby fan

4010 LOCATION:

Install fans in positions indicated, in accordance with manufacturer's instructions and recommendations in the HEVAC Fan Application guide

4020 ATTITUDE:

Mount impeller shaft horizontally unless otherwise indicated

4030 ALIGNMENT:

Ensure fan is installed aligned to allow optimum air flow path

4040 TESTING:

Ensure fan is isolated from installation during air leakage testing of ductwork

4050 DRAIN CONNECTION:

Fit trap to drain connection at lowest point of scroll on centrifugal fans where indicated

3.24 AIR FILTRATION**1000 GENERAL****1010 PRESSURE LOSS DATA:**

Provide pressure data as initial pressure loss at rated airflow and recommended final pressure loss

1020 AIR FLOW THROUGH MEDIA:

Provide filter media surface of area and layout to achieve optimum air velocity through media

1030 SEALS:

Provide filters with edge seals as appropriate to prevent air by-passing
Ensure seals remain effective after removal and replacement of cells

2010A CASINGS WITH BOLTS, NUTS AND WASHERS FIXING:

Ensure casings are robust to prevent distortion
Drill steel section end frames for bolts, nuts and washers, and rivets

2010B CASINGS WITH CAPTIVE NUTS OR TAPPED HOLES FIXING:

Ensure casings are robust to prevent distortion
Drill steel section end frames for captive nuts or tapped holes

2010C CASINGS WITH CLIPS:

Ensure casings are robust to prevent distortion
Drill steel section end frames for clips

2020A FILTER TESTING TO BS EN 779:

Test filters in accordance with BS EN 779
Testing for ignitability to BS 9999

2020B FILTER TESTING TO BS 3928:

Test filters in accordance with BS 3928

Testing for ignitability to BS 9999

2020C FILTER TESTING TO BS EN 1822:

Test filters in accordance with BS EN 1822

Testing for ignitability to BS 9999

2040B PANEL FILTERS, ALUMINIUM FRAME:

Ensure filter media is retained in frame

Provide disposable filter media of glass fibre with scrim or composite fibre material

Filter frame - aluminium

2040C PANEL FILTERS, STEEL FRAME:

Ensure filter media is retained in frame

Provide disposable filter media of glass fibre with scrim or composite fibre material

Filter frame

Light gauge mild steel with corrosion resistant coating

2050A BAG FILTERS:

Ensure media retains its shape during full air-flow conditions

Material

Provide synthetic or micro-fine glass fibre with reinforced backing mat

Supply holding frame from material suitable for application complete with sealing gasket located in holding frame

3010A PRESSURE GAUGE, DIAL TYPE:

Dial type differential pressure gauge. Clearly mark gauge with positions equivalent to "Filter Dirty" and "Filter Clean" conditions

Connect gauge to duct mounting with PVC tubing

Fix external to unit to allow easy observation. Mount within 3m of filter

3010B PRESSURE GAUGE, INCLINED MANOMETER:

Inclined manometer type differential pressure gauge. Clearly mark scale with positions equivalent to "Filter Dirty" and "Filter Clean" conditions

Connect gauge to duct mounting with PVC tubing

Fix external to unit to allow easy observation. Mount within 3m of filter

3010C PRESSURE GAUGE, PRESSURE DIFFERENTIAL SWITCH:

Pressure differential switch for visual or audio warning of "Filter Blocked Condition"

3070A MOUNTING FRAMES:

Where filter is mounted in walls or partitions, provide matching frames complete with building-in ties

4010 LOCATION:

Assemble filter in location indicated

4020A ACCESS FOR MAINTENANCE:

Provide access for changing filter media

Provide access for maintenance of motor drive and associated control equipment without disturbing filter media

Provide access for total duct maintenance

3.25 HEATING / COOLING COILS**1000 GENERAL****2010A HOT WATER HEATING COILS, COPPER WITH ALUMINIUM FINNS:**

Materials:

- Tubes - copper to BS EN 12451.
- Fins - aluminium.
- Headers - manufacturer's standard
- Casing - manufacturer's standard

Casing:

- Make provision for coil expansion
- Enclose body of coil, headers and bends within casing
- Draining and venting
- Provide plugged connections in headers to allow fitting of drain cocks/air vents and provide coil complete with venting and draining devices

Coil Testing:

- Pressure test coils to a minimum of 1.5 times design working pressure to ensure leak tight manufacture, and provide signed test certificates. Base coil design and sizing on performance test figures in line with BS 5141-2 for heating coils

Packaging:

- Fit protection for fins prior to dispatch
- Protect coils from dirt after manufacture by fitting blank flanges/caps to pipe connections

2010B HOT WATER HEATING COILS, COPPER WITH COPPER FINNS:

Materials:

- Tubes - copper to BS EN 12451
- Fins - copper
- Headers - manufacturer's standard
- Casing - manufacturer's standard

Casing:

- Make provision for coil expansion
- Enclose body of coil, headers and bends within casing

Draining and venting:

- Provide plugged connections in headers to allow fitting of drain cocks/air vents and provide coil complete with venting and draining devices

Coil Testing:

- Pressure test coils to a minimum of 1.5 times design working pressure to ensure leak tight manufacture, and provide signed test certificates. Base coil design and sizing on performance test figures in line with BS 5141-2 for heating coils

Packaging:

- Fit protection for fins prior to dispatch
- Protect coils from dirt after manufacture by fitting blank flanges/caps to pipe connections

2010E CHILLED WATER COOLING COILS, COPPER WITH COPPER FINES:**Materials:**

- Tubes - copper to BS EN 12451
- Fins - copper
- Headers - manufacturer's standard.
- Casing - manufacturer's standard

Casing:

- Make provision for coil expansion
- Enclose body of coil, headers and bends within casing

Draining and venting:

- Provide plugged connections in headers to allow fitting of drain cocks/air vents and provide coil complete with venting and draining devices
- Arrangement - Supply fins in vertical plate arrangement for cooling coils

Drain pan:

- Provide drainage facility to avoid standing water

Coil Testing:

- Pressure test coils to a minimum of 1.5 times design working pressure to ensure leak tight manufacture, and provide signed test certificates. Base coil design and sizing on performance test figures in line with BS 5141-1 for cooling coils

Packaging:

- Fit protection for fins prior to dispatch
- Protect coils from dirt after manufacture by fitting blank flanges/caps to pipe connections

3010 DRIP TRAYS:

Incorporate drip tray into base of casing to collect condensate

Fit at a small gradient towards drain socket provided in bottom of tray

Extend tray under external headers/return bends where these are not insulated/vapour sealed. Extend tray, or provide additional tray, where eliminator plates are fitted

Provide removable drip trays

Where coils are over 1200mm high provide additional drip trays at 1200mm centre intervals maximum over height of coils, piped in copper or plastic to discharge into base tray

Paint internal surfaces with two coats of epoxy resin or alternative water proofing compound

3020A GLASS DRAIN TRAPS UNDER SUCTION:

Provide drain trap at least twice working air pressure in depth. Provide an air break between trap outlet and drainage system

Ensure traps under suction have outlet lower than inlet by depth equivalent to at least one and a half times working pressure

Material - Glass

3020B GLASS DRAIN TRAPS UNDER PRESSURE:

Provide drain trap at least twice working air pressure in depth. Provide an air break between trap outlet and drainage system

Ensure traps under positive pressure have inlet and outlet at same level

Material - glass

3030 ELIMINATOR PLATES:

Install bank of eliminator plates downstream of coils to prevent carryover of condensate at design air face velocity. Fit plates to allow independent removal from coil casing

Ensure material of eliminators is compatible with casing

3040 MOUNTING FRAME:

On heating coils provide mounting frame for grouting into wall as necessary

3050A AHU DUCT CONNECTIONS:

To match air handling unit and specified method of assembly

3050B EXTERNAL FLANGE DUCT CONNECTIONS:

With external flanges drilled for bolting to counter flanges on adjacent plant or ductwork

3050C INTERNAL FLANGE DUCT CONNECTIONS:

With internal flanges drilled for bolting to counter flanges on adjacent plant or ductwork

3050D SPIGOT DUCT CONNECTIONS:

With spigot duct connections

4010 POSITION/LOCATION:

Install coils in air distribution system as indicated. Locate coils in positions where air velocity is substantially equal over face of approach duct

Arrange steam coils for horizontal air flow

Ensure equipment, controls and instruments positioned adjacent to heating coils are not adversely affected by thermal radiation

4020A COOLING COIL CONNECTIONS:

Provide a drain line incorporating deep seal trap

4020B HEATING COIL CONNECTIONS:

Arrange pipe connections to take up thermal expansion movement without imposing stress on coil

4040 PROTECTION:

Protect coils from damage and ingress of dirt during the course of contract

Restore fins and other parts of coils to original condition if any damage has occurred

Ensure all connected ductwork is thoroughly clean before removing protection and passing air through system

3.26 SILENCERS / ACOUSTIC TREATMENT**1000 GENERAL****1010 PERFORMANCE:**

Ensure that specified performance is met where protection is applied to infill to protect from moisture and grease

1020 TESTING:

Provide certified insertion loss data in accordance with BS EN ISO 7235. Provide generated sound power levels with insertion loss data

Where equipment is manufactured in modules ensure performance ratings apply to complete unit

1030 PROTECTION:

Protect silencers where they are installed in positions exposed to external weather conditions

Block ends of silencers prior to delivery to site to prevent damage

1040 DIRECTION OF FLOW:

Clearly mark direction of air flow on silencers

2010A FIRE PROPERTIES, BS 476-7, CLASS 1:

Use non-flammable adhesives

Ensure that all insulating materials and coverings are non-combustible material covered with a material that complies with flame spread requirements of BS 476-7, class 1

2010B FIRE PROPERTIES, BUILDING REGULATIONS, CLASS O:

Use non-flammable adhesives

Ensure that all insulating materials and coverings are to class O surface rating of building regulations

2020A CIRCULAR SILENCERS - CASING TO DW144 WITH EXTERNAL FLANGES:

Provide circular silencers compatible with ductwork installation. Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic

Construct casing to DW 144 with external flanges drilled for bolting to counter flanges on adjacent plant or ductwork

2020B CIRCULAR SILENCERS - CASING TO DW144 WITH INTERNAL FLANGES:

Provide circular silencers compatible with ductwork installation. Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic

Construct casing to DW 144 with internal flanges drilled and threaded for bolting to counter flanges on adjacent plant or ductwork

2020C CIRCULAR SILENCERS - CASING TO DW144 WITH SPIGOT ENDS:

Provide circular silencers compatible with ductwork installation

Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic

Construct casing to DW 144 with plain spigot ends for connection to adjacent plant or ductwork

2030A CIRCULAR SILENCERS - NON-METAL WITH EXTERNAL FLANGES:

Provide circular silencers compatible with ductwork installation

Provide with external flanges drilled for bolting to counterflanges on adjacent plant or ductwork

2030B CIRCULAR SILENCERS - NON-METAL WITH INTERNAL FLANGES:

Provide circular silencers compatible with ductwork installation

Provide with internal flanges drilled and threaded for bolting to counter flanges on adjacent plant or ductwork

2030C CIRCULAR SILENCERS - NON-METAL WITH SPIGOT ENDS:

Provide circular silencers compatible with ductwork installation

Provide with plain spigot ends for connection to adjacent plant or ductwork

2040A RECTANGULAR SILENCERS - CASING TO DW144 WITH CONNECTIONS TO MATCH AHU:

Provide rectangular silencers compatible with ductwork installation. Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic

Construct splitters with manufacturer's standard ends
Construct casing to DW 144 with duct connections to match the air handling unit and specified method of assembly

2040B RECTANGULAR SILENCERS - CASING TO DW144 WITH EXTERNAL FLANGES:

Provide rectangular silencers compatible with ductwork installation. Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic
Construct splitters with manufacturer's standard ends
Construct casing to DW 144 with external flanges drilled for bolting to counter flanges on adjacent plant or ductwork

2040C RECTANGULAR SILENCERS - CASING TO DW144 WITH INTERNAL FLANGES:

Provide rectangular silencers compatible with ductwork installation. Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic
Construct splitters with manufacturer's standard ends
Construct casing to DW 144 with internal flanges drilled and threaded for bolting to counter flanges on adjacent plant or ductwork

2060A ACOUSTIC SPLITTERS TO MANUFACTURER'S STANDARD:

Mount splitters vertically or horizontally and fix splitters as shown on drawings
Construct splitters to ensure that infill is retained and individual acoustic integrity is maintained
Construct splitters with manufacturer's standard ends
Provide additional stiffening on horizontally mounted splitters
Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic
Material
Non-combustible mineral wool or glass fibre with minimum density 48 kg/m³
Retain infill by perforated galvanized mild steel sheet

2060B ACOUSTIC SPLITTERS WITH LOW LOSS FAIRINGS:

Mount splitters vertically or horizontally and fix splitters as shown on drawings
Construct splitters to ensure that infill is retained and individual acoustic integrity is maintained
Construct splitters with low loss fairings
Provide additional stiffening on horizontally mounted splitters
Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic
Material
Non-combustible mineral wool or glass fibre with minimum density 48 kg/m³
Retain infill by perforated galvanized mild steel sheet

2070A AIR TRANSFER/CROSS TALK ATTENUATORS - EXTERNAL FLANGES:

Provide attenuators for air transfer and cross talk applications. Provide lining that is inert, fire proof, inorganic, vermin proof, non-hygroscopic

Construct casing with lock-formed longitudinal joints, mastic sealed. Provide external flanges drilled for bolting to counter flanges on adjacent ductwork

Fixing

Interface with building components as indicated

2070C AIR TRANSFER/CROSS TALK ATTENUATORS - SPIGOT ENDS:

Provide attenuators for air transfer and cross talk applications. Provide lining that is inert, fire proof, inorganic, vermin proof, non-hygroscopic

Construct casing with lock-formed longitudinal joints, mastic sealed. Provide plain spigot ends for connection to adjacent ductwork

Fixing

Interface with building components as indicated

2100A PLENUMS:

Provide plenum constructed using acoustic panels in positions indicated. Joint panels with seals to match performance of panels

Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic

Material - polyurethane foam

Performance

Minimum random incidence absorption coefficients in accordance with BS EN ISO 354, as indicated

3040 SUPPORTS:

Supply steel section supporting frames or brackets where silencers are fixed to the walls of air chambers

3060 SOUND PRESSURE LEVEL READINGS:

Measure sound pressure levels at the positions indicated using equipment in accordance with BS EN 61672-1 and BS EN 61672-2

3.27 GRILLES / DIFFUSERS / LOUVRES

1000 GENERAL

1010 PERFORMANCE:

Air Supply - Ensure air velocity at occupancy level is not greater than 0.45 m/s

Blades - Supply grilles and diffusers with blade profile to ensure correct aerodynamic performance and minimal noise generation

Louvres - ensure air velocities through face area of louvres minimises "carry-over" of rain, snow or other precipitation into ducts, shafts or plant rooms

1020 SIZE:

Sizes indicated are "Nominal"

Provide site dimensions of linear diffusers and grilles before manufacture

1030 NOISE LEVELS:

Ensure sound power levels indicated are not exceeded. Ensure accessories for grilles and diffusers have low noise generation characteristics, and cause minimum disturbance to airflow

1033 PROTECTIVE WRAPPING:

Apply protective wrapping to exposed architectural finishes prior to dispatch to site

1035 TESTING:

Provide air terminal devices tested in accordance with BS EN ISO 5135, and BS EN 13030

1040 ELECTRICAL BONDING TERMINAL:

Ensure an electrical bonding terminal suitable for connection of 6mm² maximum conductor is provided on metal grilles, diffusers and louvres where indicated

2010A GRILLES - FIXED BLADE TYPE:

Secure blades within flanged mounting frame or core collar. Provide support mullions to ensure blade stability

Style, blade rows and air pattern control as indicated on schedule

2020A GRILLES - ADJUSTABLE BLADE TYPE:

Pivot blades within flanged mounting frame and retain blades in set position by tensioners external to the airstream

Provide blade rows and blade angle adjustment as indicated on schedule

2070A GRILLES - SIGHTPROOF NON-VISION TYPE:

Supply sight-proof non-vision grilles with one set of blades at centres indicated

Fix within a flanged mounting frame or a core box as indicated

2100 DIFFUSERS - PERFORATED FACE TYPE:

Supply perforated face diffusers with rigid and smooth inlet spigot expanded to butt and seal against easily removable framed perforated front panel

Incorporate back deflectors above front panel, set to give required performance

Supply type and profile of framed perforated front panel to mount flush with surrounding false ceiling panels

2110A ADJUSTABLE CURVED BLADE DIFFUSER:

Supply diffusers manufactured from curved cross sectional profile parallel blades pivoted at each end within flanged mounting frame. Ensure that each blade is individually adjustable to give directional control of airstream Retain blades in set position by tensioners external to airstream

Control ways as indicated on drawings

2120A ADJUSTABLE CURVED BLADE DIFFUSER WITH REMOVABLE INNER CORE:

Supply diffusers manufactured from curved cross sectional profile parallel blades within removable core frame and include integral multi-blade volume control at each blade set. Ensure assembly is removable from flanged mounting frame

Make provision for volume control adjustment by loose key

Ensure that each blade within core is individually adjustable, and that each core is designed to give directional control of airstream through each 90° angle

Control ways as indicated on drawings

2130A STRAIGHT LINE, FIXED LOUVRE DIFFUSER WITH FIXED CORE:

Supply diffusers manufactured from louvre type parallel blades permanently set and securely fixed within frame

Pre-set each blade to give directional control of airstream

Control ways as indicated on drawings

2130B STRAIGHT LINE, FIXED LOUVRE DIFFUSER WITH REMOVABLE CORE:

Supply diffusers manufactured from louvre type parallel blades permanently set and securely fixed within frame

Supply core frames which are easily removable from flanged mounting frame

Pre-set each blade to give directional control of airstream

Control ways as indicated on drawings

2170A HIGH INDUCTION DIFFUSERS, SECONDARY AIR INDUCTION:

Supply high induction diffusers fixed or variable geometry using secondary air induction into diffuser housing

2190A LOUVRES - EXTERNAL AIR SUPPLY/EXTRACT TYPE:

Performance - ensure louvre withstands specified wind loads and prevent ingress of rain

Construction - construct louvre frame and aerodynamically profiled louvre blades from galvanized mild steel or aluminium as indicated

Provide integral drainage channels

Retain infill on louvre blades by perforated sheet of galvanized mild steel or aluminium as indicated

Screen - fit a bird-screen using mesh no coarser than 12mm, across inside face of louvres

Quality assurance - ensure manufacturers are a firm of assessed capability to BS EN ISO 9001 and produce louvre to relevant quality assessment schedule

2220A GRILLE AND DIFFUSER CONSTRUCTION:

Ensure grilles and diffusers are robust and mounting frame flanges on square and rectangular terminals have mitred corners. Fit a rubber or plastic foam sealing strip or gasket to rear face of flange

Diffusers - ensure face of diffuser outer cone or frame is completely smooth

2230A LOUVRE CONSTRUCTION:

Ensure louvres are robust. Incorporate in purpose made sub-frame. Provide drip cills as indicated

3010A OPPOSED BLADE VOLUME CONTROL DAMPERS - LOCAL CONTROL:

Balance and tension operating mechanisms to give positive setting for blade positions from fully open to fully closed

Local blade operation

Supply device for operating damper blades through face or side of grille/diffuser as indicated

3010B OPPOSED BLADE VOLUME CONTROL DAMPERS - REMOTE CONTROL:

Balance and tension operating mechanisms to give positive setting for blade positions from fully open to fully closed

Remote blade operation

Supply remote control with necessary brackets and linkage at control unit

3040A BUTTERFLY VOLUME CONTROL DAMPERS:

Operate via a simple hooked wire key connecting with a lug on the underside of each plate; or by a loose key locating into a control mechanism

3050A "IRIS" VOLUME CONTROL DAMPERS:

When in fully open setting ensure that unit inside diameter is equal to full internal diameter of air diffuser spigot, or ducting branch connection

Method of operation as indicated on the schedule

3060A FIXED AIR FLOW DEFLECTORS:

Direct airstream evenly from main ducting into branches or spigots serving air grilles and diffusers by using a number of equally spaced curved blades linked together

3070 BLANKING PLATES:

Supply blanking plates to restrict projection of air flow from a particular section of grille or diffuser

Ensure that indicated dimensions or angles in degrees are maintained

3090 PERFORATED SCREENS:

Fit perforated screens behind grille volume control devices to equalize air flow and pressure
Contain perforated sheet within rigid surrounding frame, incorporating fixing brackets or lugs

3120A HINGED LOUVRE ACCESS PANELS AND DOORS:

Incorporate purpose made access panels or doors within body of louvres, manufactured from compatible materials
Use hinged access panels or doors of single or double style and with front or rear locking facilities

3120B LIFT OUT LOUVRE ACCESS PANELS AND DOORS:

Incorporate purpose made access panels or doors within body of louvres, manufactured from compatible materials
Use permanent housed or lockable lift out access panels

3130 SPARES:

Supply indicated number of loose keys, suitable for adjusting each size and type of grille, or operating accessories

4010 GRILLE/DIFFUSER LOCATION:

Fit at terminal air supply, extract and transfer points indicated, in accordance with the HEVAC Air Diffusion guide

4040 CONNECTION TO DUCTWORK:

When connecting directly to duct spigot, secure grille mounting frame or flange with screws, or bolts and nuts, to returned flange, with filled in corners, at end of duct spigot

4050A INSTALLATION IN BUILDERS WORK:

Ensure outer edge of grille mounting frame or flange extends on all sides beyond the joint between any builders work frame and surrounding building construction
Ensure grilles are sealed to building fabric - including ceilings, to prevent air leakage from pressurised rooms to voids above
Fix louvres to building fabric using method indicated on drawings

3.28 FLEXIBLE JOINTS

The materials used for flexible joints shall withstand any conditions of temperature, air pressure and fire protection specified.

Flexible joints shall be fitted to suction and delivery connections to all fans and at expansion joints in the building.

On rectangular connections, the materials shall be held in place by a mating flange with a backing plate. All clipbands shall be manufactured from stainless steel.

All flexible materials shall not support combustion, shall be flame proof and shall be to the complete satisfaction of the local authorities.

Flexible joints shall be as short as possible and in all cases not exceeding 250mm long.

3.29 CONNECTION TO EXTERNAL LOUVRES

At all connections to louvres, the bottom of the duct shall slope down towards the opening to prevent water entering the system. The inside of the duct shall be coated with black bitumastic paint for a distance of not less twice the height of the opening.

The ductwork shall be extended over the bottom louver blade such that any water entering shall run out through the louver. This extension shall not be visible from outside.

All areas of louvres which are not used as air intakes or discharges shall be blanked off using galvanised sheet suitably stiffened to prevent drumming. The galvanised sheeting shall be painted to match the colour of the louver such that any visible parts match.

3.30 MANOMETERS

The sub contractor shall include for all filters to be provided with manometers to indicate the differential pressure across the filter.

These shall be of the inclined type, the gauge fluid shall be blended paraffin dyed bright red. The gauge shall have zero adjustment and markers indicating 'dirty' and 'clean' filter.

Position of all manometers shall be approved by the Consulting Engineer.

3.31 EXTERNAL DUCTWORK

All ductwork mounted externally shall be suitably primed and painted with black bitumastic paint in accordance with DW144.

If supported off a flat roof, then approval of the proposed method of support shall be required by the Consulting Engineer prior to any installation. A detailed drawing indicating the proposed methods shall be submitted.

3.32 THERMAL INSULATION - GENERAL

The sub contractor shall include for all thermal insulation work, which shall be carried out by an approved specialist thermal insulation sub contractor.

The thermal insulation specialist shall be acquainted with all of the conditions of the works i.e. specification, programme, hours of working etc., and shall complete his own work within the specified period of the contract programme.

The insulation work shall not commence until all the testing of particular sections of works have been carried out. Any insulation applied and subsequently removed to repair leaking pipework etc, shall be replaced to the same standard without extra cost to the project.

The insulation works shall be carried out in accordance with all relevant Codes of Practice and British Standard Specifications.

The Consulting Engineer reserves the right not to accept any work of inferior quality or badly finished work. All joints, surface finishes, edges and overlaps shall not be allowed if they are of an irregular or dangerous nature.

Where it is obvious that damage may occur, it is the responsibility of the thermal insulation contractor to suitably protect the insulation as soon as it is applied and until such times that the building is handed over. Any damaged work shall be removed and replaced back to the specified standard, prior to handover and at no additional expense to the project.

Section one of this specification shall stipulate the insulation requirements of this particular project abstracting certain specification details from the following tables etc. Thermal insulation shall be as manufactured by Kingspan, Rockwool or equal and approved

1000 GENERAL

1010 TEMPERATURE RANGE:

Refer to insulation manufacturer's recommendations to determine suitability of different insulation materials at different temperature ranges

1020 STANDARDS:

Comply in general with BS EN ISO 12241
Use the description of terms as BS 3533

1030 MATERIALS:

Employ materials that comply with BS 476-7
Ensure metals and materials that cause galvanic corrosion are not installed in contact
Do not use galvanized or zinc coated steel jacketing and accessories on austenitic stainless steel and austenitic nickel steel/alloy equipment and piping

1032 PRE-INSULATED EQUIPMENT:

Where fire and surface spread of flame certificates relate to factory made products, ensure that certificates are still valid where products are incorporated in pre-insulated equipment

1034 PROTECTION APPLIED IN SITU:

Where fire and surface spread of flame certificates relate to factory made products, ensure that the certificate remains valid when the finish is site applied

1050A SPREAD OF FLAME:

When completed, ensure surface-finish complies with BS 476-7 Class 1 spread of flame

1055A SMOKE EMISSION CHARACTERISTICS:

Supply materials classified as less than 5% smoke obscuration rating when tested in accordance with BS EN ISO 5659-2

1080 ELECTRICAL BONDING TERMINAL:

Ensure an electrical bonding terminal suitable for connection of 6mm² maximum conductor is provided where indicated

1090 INSPECTION AND TESTING:

Arrange performance test of thermal conductivity on materials selected, carried out at manufacturer's works or at an approved laboratory and in accordance with appropriate British Standard

2010 THERMAL CONDUCTIVITY:

Ensure values are in accordance with BS EN 12664, BS EN 12667, BS EN 12939 or BS EN ISO 8990

2015A THERMAL PERFORMANCE LIFE EXPECTANCY FOR PLANT DESIGN LIFE:

Ensure the insulation shall maintain its thermal performance for a minimum of the plant design life

2015B THERMAL PERFORMANCE LIFE EXPECTANCY DETAILS:

Provide manufacturer's details which define the life expectancy of the insulation material

2020 RESTRICTIONS ON USE OF MATERIALS:

Protect insulated stainless steel surfaces from the risk of stress corrosion in accordance with the recommendations in BS 5970

2030A FOIL FACED ROCK MINERAL FIBRE PIPE INSULATION:

Standard - BS 3958-4

Nominal density - 80 kg/m³ to 120 kg/m³. Thickness - 20mm to 100mm

Thermal conductivity - rock mineral Fibre

Not exceeding 0.038 W/mK at a mean temperature of 50°C

Finish - reinforced aluminium foil with at least 25mm overlap

2030C FOIL FACED GLASS FIBRE PIPE INSULATION:

Standard - BS 3958-4

Nominal density - 80 kg/m³ to 120 kg/m³. Thickness - 20mm to 100mm

Thermal conductivity - not exceeding 0.035 W/mK at a mean temperature of 50°C

2040A FOIL FACED ROCK MINERAL FIBRE RIGID DUCT INSULATION:

Standard - BS 3958-5

Nominal density - 45 - 48 kg/m³

Thickness - 25mm to 100mm

Thermal conductivity - not exceeding 0.04 W/mK at a mean temperature of 50°C

Finish - reinforced aluminium foil

2110A FOIL FACED CLOSED CELL RIGID PHENOLIC FOAM (PF) PREFORMED SECTIONS:

Nominal density - refer to manufacturer's recommendations

Temperature range - refer to manufacturer's recommendations

Thickness - minimum 15mm

Thermal conductivity - not exceeding 0.021 W/mK at a mean temperature of 10°C

Finish - reinforced aluminium foil

2110B CLOSED CELL RIGID PHENOLIC FOAM (PF) PREFORMED SECTIONS:

Nominal density - refer to manufacturer's recommendations

Temperature range - refer to manufacturer's recommendation

Thickness - minimum 15mm

Thermal conductivity - not exceeding 0.021 W/mK at a mean temperature of 10°C

2120A FOIL FACED CLOSED CELL RIGID LAMINATED PHENOLIC FOAM (PF), DUCT INSULATION SLAB:

Standard - BS EN 13166

Nominal density - refer to manufacturer's recommendations

Thickness - minimum 20mm

Thermal conductivity - not exceeding 0.021 W/mK at a mean temperature of 10°C

Finish - reinforced aluminium foil

2120B CLOSED CELL RIGID LAMINATED PHENOLIC FOAM (PF), DUCT INSULATION SLAB:

Nominal density - refer to manufacturer's recommendations

Thickness - minimum 20mm

Thermal conductivity - not exceeding 0.021 W/mK at a mean temperature of 10°C

2130A HIGH DENSITY RIGID PHENOLIC PIPE AND DUCT INSULATION:

Nominal density - refer to manufacturer's recommendations

Temperature range: -180 to +120°C

Thermal conductivity - not exceeding 0.040 W/mK at a mean temperature of 50°C. CFC and HCFC free

2140A CLOSED CELL NITRILE RUBBER ELASTOMERIC SHEET AND PREFORMED FLEXIBLE SECTIONS:

Nominal density - 90 - 100 kg/m³

Temperature range: -40 to +105°C

Thickness

Sections - 13mm to 25mm for pipe sizes 15mm to 100mm. Sheets - 6mm to 25mm

Thermal conductivity - not exceeding 0.04 W/mK at a mean temperature of 20°C

2170A VAPOUR BARRIER PERMEANCE:

Do not exceed the following permeance values for vapour barriers

Permeance values

Cold water pipework - 0.05g/sMN

Chilled water pipework - 0.015g/sMN

Refrigeration pipework - 0.010g/sMN

2180A BITUMEN VAPOUR BARRIER COATINGS:

Cut-back bitumens with cotton canvas or open mesh glass cloth to reinforce coatings

2180B VINYL VAPOUR BARRIER COATINGS:

Vinyl emulsions with cotton canvas or open mesh glass cloth to reinforce coatings

2180C SOLVENT POLYMER VAPOUR BARRIER COATINGS:

Solvent-based polymers with cotton canvas or open mesh glass cloth to reinforce coatings

2180D BITUMEN EMULSION VAPOUR BARRIER COATINGS:

Bitumen emulsions (with or without elastomer latex) with cotton canvas or open mesh glass cloth to reinforce coatings

2190 ADHESIVES:

Comply with the recommendations of clause 8.2 of BS 5970, section 2 for insulation bonding adhesives, lagging adhesives; and facing and film attachment adhesives

2200A SELF ADHESIVE WEATHER RESISTANT ZERO PERM MULTI-LAYER LAMINATE:

Apply multi-layer laminate directly over ducts and pipework, ensuring 75mm overlap for a complete vapour barrier

2200C FLAT ALUMINIUM-ZINC COATED STEEL PROTECTION:

Mild steel sheet continuously hot dipped with 185gm aluminium-zinc coating to BS EN 10327, applied directly to insulating material
0.4mm thick flat sheet

2200D RIBBED ALUMINIUM-ZINC COATED STEEL PROTECTION:

Mild steel sheet continuously hot dipped with 185gm aluminium-zinc coating to BS EN 10327, applied directly to insulating material
0.4mm thick ribbed sheet

2200E ALUMINIUM SHEETING PROTECTION:

Apply flat (embossed) or profiled aluminium cladding directly to insulating material.
0.56mm thick on pipework; 0.71mm thick on ductwork

2210A REINFORCEMENT:

Aluminium bands at 300mm centres
Aluminium bands at 450mm centres
50mm x 19g galvanised wire netting to BS EN 10223
50mm x 22g galvanised wire netting to BS EN 10223

2220A VALVE AND FLANGE INSULATION - ALUMINIUM CASING:

Install insulation on flanges and valves

2200E ALUMINIUM SHEETING PROTECTION:

Use a protected metal split casing fabricated from 0.91mm aluminium sheet fitted with spring clip fasteners, filled with insulating material with same thermal performance as insulation on adjoining pipe

2220B VALVE AND FLANGE INSULATION - ALUMINIUM-ZINC COATED STEEL CASING:

Install insulation on flanges and valves
Use a protected metal split casing fabricated from 0.7mm aluminium-zinc coated steel sheet fitted with spring clip fasteners, filled with insulating material with same thermal performance as insulation on adjoining pipe

2220C CLOSED CELL VALVE AND FLANGE INSULATION - COLD APPLICATIONS:

Install insulation on flanges and valves

Enclose cold piping valve bodies and flanges with closed cell insulating material to maintain vapour barrier

2230A ALUMINIUM PROTECTION FOR HEAT EXCHANGERS AND OTHER VESSELS:

Finish with 0.9mm thick aluminium ribbed or embossed sheeting, with lapped, riveted and sealed joints, laps to shed water

Seal all joints at manholes and stools

Fit cut-outs with purpose made over-plates or collars

2230B ALUMINIUM PROTECTION FOR HEAT EXCHANGERS AND OTHER VESSELS - WITH CHEST AND ACCESS COVERS:

Finish with 0.9mm thick aluminium ribbed or embossed sheeting, with lapped, riveted and sealed joints, laps to shed water. Seal all joints at manholes and stools. Fit cut outs with purpose made over-plates or collars

Enclose chests and access covers in removable covers lined with high density flexible material

Remove manufacturer's name plate and refix on cladding

2230E MULTI-LAYER LAMINATE PROTECTION FOR HEAT EXCHANGERS AND OTHER VESSELS - WITH CHEST AND ACCESS COVERS:

Finish with self-adhesive weather resistant zero perm multi-layer laminate to encapsulate insulation, using the taped system as a quick and easy access point

2285 CALCULATION OF INSULATION THICKNESS:

Provide insulation of thickness conforming with calculations in accordance with BS EN ISO 12241 using the standardised assumptions within BS 5422 table 13 - warm air ductwork and Table 14 - chilled and dual-purpose ductwork

2286 CALCULATION OF INSULATION THICKNESS - BUILDING REGULATIONS (ENGLAND AND WALES):

Provide insulation of thickness conforming with the requirements of the Building Regulations (England and Wales) Part L approved documents, and the calculation methods given in BS EN ISO 12241 using the standardised assumptions within BS 5422 table 13 - warm air ductwork and table 14 - chilled and dual-purpose ductwork

2300 NON-DOMESTIC HOT WATER SERVICE AREAS - PHENOLIC FOAM:

Environmental insulation thickness for non-domestic hot water service areas to control heat loss, aged K-value:

Outside diameter of steel pipe	Thickness of phenolic foam
--------------------------------	----------------------------

(mm)	(mm)
17	15
21	15
27	15
34	20
42	20
48	20
60	20
76	25
89	25
114	25
140	25
168	25
Outside diameter of steel pipe (mm)	Thickness of phenolic foam (mm)
219	30
273	30
Above 273 & flat surfaces	30

Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter

Use this table for insulation thickness of plastic pipework of the nearest equivalent outside diameter

2305 NON-DOMESTIC HOT WATER SERVICE AREAS, BUILDING REGULATIONS - PHENOLIC FOAM:

Environmental insulation thickness for non-domestic hot water service areas to control heat loss, in accordance with the requirements of the Building Regulations (England and Wales) Part L2 approved documents and the calculation methods given in BS EN ISO 12241:

Outside diameter of steel pipe (mm)	Thickness of phenolic foam (mm)
17	15
21	15
27	15
34	20
42	20
48	20
60	20
76	25
89	25
114	25
140	25
168	25
219	30
273 and above	30

Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter

Use this table for insulation thickness of plastic pipework of the nearest equivalent outside diameter

2306 NON-DOMESTIC HOT WATER SERVICE AREAS, BUILDING REGULATIONS - NITRILE RUBBER:

Environmental insulation thickness for non-domestic hot water service areas to control heat loss, in accordance with the requirements of the Building Regulations (England and Wales) Part L2 approved documents and the calculation methods given in BS EN ISO 12241:

Outside diameter of steel pipe (mm)	Thickness of nitrile rubber (mm)
17	31
21	33
27	35
34	37
42	38
48	40
60	41
Outside diameter of steel pipe (mm)	Thickness of nitrile rubber (mm)
76	44
89	44
114	45
140	46
168	47
219	47
273 and above	49

Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter

Use this table for insulation thickness of plastic pipework of the nearest equivalent outside diameter

The above thicknesses relate to Class O rated insulation. The thicknesses may vary for other ratings

2320 NON-DOMESTIC HEATING INSTALLATIONS - PHENOLIC FOAM:

Environmental insulation thickness for non-domestic heating installations to control heat loss, aged K-value

Adjust thicknesses to comply with BS 5422:

Outside diameter of steel pipe (mm)	Temperature of contents °C	
	75	100
	Thickness of rigid phenolic insulation (mm)	
17	15	20
21	15	20
27	20	20
34	20	25
42	25	25
48	20	25
60	25	30
76	25	30
89	25	35
114	30	35
140	30	40
168	30	40
219	30	40
273	35	45

Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter

2325 NON-DOMESTIC HEATING INSTALLATIONS, BUILDING REGULATIONS - PHENOLIC FOAM:

Environmental insulation thickness for non-domestic heating installations to control heat loss, in accordance with the requirements of the Building Regulations (England and Wales) Part L2 approved documents, and the calculation methods given in BS EN ISO 12241:

Outside diameter of steel pipe (mm)	Temperature of contents °C	
	<95	96-120
	Thickness of phenolic foam insulation (mm)	
17	15	15
21	15	15
27	20	22
34	20	25
42	20	30
48	25	30
60	25	35
76	25	35
89	25	35
114	30	40
140	30	45
168	30	45
219	35	45
273 and above	35	45

2326 NON-DOMESTIC HEATING INSTALLATIONS, BUILDING REGULATIONS - NITRILE RUBBER:

Environmental insulation thickness for non-domestic heating installations to control heat loss, in accordance with the requirements of the Building Regulations (England and Wales) Part L2 approved documents, and the calculation methods given in BS EN 12241:

Outside diameter of steel pipe (mm)	Temperature of contents °C
	<95
	Thickness of nitrile rubber insulation (mm)
17	15
21	15
27	20
34	20
42	20
48	25
60	25
76	25
89	25
114	30
140	30
168	30
219	35
273 and above	35

Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter

The above thicknesses relate to Class O rated insulation. The thicknesses may vary for other ratings

2336 DOMESTIC CENTRAL HEATING AND HOT WATER SYSTEMS - PHENOLIC FOAM:

Environmental insulation thickness for domestic central heating installations and hot water systems in potentially unheated areas to control heat loss in accordance with the requirements of the Building Regulations (England and Wales) Part L1 approved documents, and the calculation methods given in BS EN ISO 12241:

Outside diameter of copper pipe (mm)	Thickness of phenolic foam insulation for water at 60°C for central heating and hot water in still air at 15°C (mm)
10	15
12	15
15	15
22	15
28	20
35	20
42	20
54	25

2337 DOMESTIC CENTRAL HEATING AND HOT WATER SYSTEMS, BUILDING REGULATIONS - NITRILE RUBBER:

Environmental insulation thickness for domestic central heating installations and hot water systems in potentially unheated areas to control heat loss in accordance with the requirements of the Building Regulations (England and Wales) Part L1 approved documents, and the calculation methods given in BS EN ISO 12241:

Outside diameter of copper pipe (mm)	Thickness of nitrile rubber insulation for water at 60°C for central heating and hot water in still air at 15°C (mm)
10	13
12	19
15	19
22	25
28	25
35	32
42	32
54	32

2360 CHILLED AND COLD WATER SUPPLIES TO PREVENT CONDENSATION - PHENOLIC FOAM, HIGH EMISSIVITY:

Minimum insulation thickness for chilled and cold water supplies to prevent condensation on a high emissivity outer surface (0.6) with an ambient temperature of 25°C and a relative humidity of 80%:

Outside diameter of steel pipe (mm)	Temperature of contents °C		
	10	5	0
	Thickness of rigid phenolic insulation (mm)		
17	15	15	15
21	15	15	15
27	15	15	15
33	15	15	15
42	15	15	15
48	15	15	15
60	15	15	15
76	15	15	15
89	15	15	15
102	15	15	15
114	15	15	15
140	15	15	15
168	15	15	15
219	15	15	15
245	15	15	15
273	15	15	20
324	15	15	20
356	15	15	20
406	15	15	20
456	15	15	20
508	15	15	20
610	15	15	20

Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter

Use this table for insulation thickness of plastic pipework of the nearest equivalent outside diameter

2380 CHILLED AND COLD WATER SUPPLIES TO PREVENT CONDENSATION - PHENOLIC FOAM, LOW EMISSIVITY:

Minimum insulation thickness for chilled and cold water supplies to prevent condensation on a low emissivity outer surface (0.05) with an ambient temperature of 25°C and a relative humidity of 80%:

Outside diameter of steel pipe (mm)	Temperature of contents °C		
	10	5	0
	Thickness of rigid phenolic insulation (mm)		
17	15	20	20
21	15	20	20
27	15	20	25
33	15	20	25
42	15	20	25
48	15	25	30
60	20	25	30
76	20	25	30
89	20	25	35
102	20	25	35
114	20	30	35
140	20	30	35
168	25	30	40
219	25	35	40
245	25	35	45
273	25	35	45
324	25	35	45
356	25	35	45
406	30	40	50
456	30	40	50
508	30	40	50
610	30	40	55

2390 CHILLED WATER SERVICES - ROCK MINERAL WOOL:

Environmental insulation thickness for chilled water supplies to control heat gain

Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter

Use this table for insulation thickness of plastic pipework of the nearest equivalent outside diameter

Outside diameter of steel pipe (mm)	Temperature of contents °C	
	5	0
	Thickness of rock mineral wool insulation (mm)	
17	25	30
21	25	30
27	30	35
34	30	35
42	30	40
48	35	40
60	35	45
76	35	45
89	40	50
114	40	50
168	45	60
219	50	60
273	50	70
508	60	80
Flat surfaces	70	80

Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter

Use this table for insulation thickness of plastic pipework of the nearest equivalent outside diameter

2400 CHILLED WATER SERVICES - PHENOLIC FOAM:

Environmental insulation thickness for chilled water supplies to control heat gain:

Outside diameter of steel pipe (mm)	Temperature of contents °C	
	5	0
	Thickness of rock phenolic foam insulation (mm)	
17	15	15
21	15	15
27	15	15
34	15	15
42	15	15
48	15	15
60	15	15
76	15	20
89	15	20
114	15	20
140	20	20
168	20	20
219	20	20
273	20	25

Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter

Use this table for insulation thickness of plastic pipework of the nearest equivalent outside diameter

2410 CHILLED AND MAINS COLD WATER SUPPLIES - CLOSED CELL NITRILE RUBBER:

Outside diameter of steel pipe (mm)	Thickness of closed cell Nitrile rubber (mm)
15	19
20	19
25	25
32	25
40	25
50	25
54	32
60	32

2411 COOLED WATER SUPPLIES, BUILDING REGULATIONS - PHENOLIC FOAM:

Environmental insulation thickness for cooled water supplies to control heat gain, in accordance with the requirements of the Building Regulations (England and Wales) Part L2 approved documents, and the calculation methods given in BS EN ISO 12241:

Outside diameter of steel pipe (mm)	Temperature of contents °C		
	>10	4.9 to 10	0 to 4.9
	Thickness of phenolic foam insulation (mm)		
17	15	20	20
21	15	20	20
27	15	20	25
34	15	20	25
42	15	20	25
48	15	25	30
60	20	25	30
76	20	25	30
89	20	25	35
114	20	30	35
140	25	30	40
168	25	30	40
219	25	35	40
273	25	35	45
Vessels and flat surfaces	30	40	55

Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter

Use this table for insulation of plastic pipework of the nearest equivalent outside diameter

2412 COOLED WATER SUPPLIES, BUILDING REGULATIONS - NITRILE RUBBER:

Environmental insulation thickness for cooled water supplies to control heat gain, in accordance with the requirements of the Building Regulations (England and Wales) Part L2 approved documents, and the calculation methods given in BS EN ISO 12241:

Outside diameter of steel pipe (mm)	Temperature of contents °C		
	>10	4.9 to 10	0 to 4.9
	Thickness of nitrile rubber insulation (mm)		
17	21	26	30
21	22	27	31
27	23	29	33
34	24	30	35
42	26	32	38
48	27	33	39
60	27	34	40
76	28	35	45
89	28	36	42
114	29	37	44
140	30	38	45
168	30	38	46
219	30	38	46
273 and above	31	39	47

Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter

Use this table for insulation thickness of plastic pipework of the nearest equivalent outside diameter

The aforementioned thicknesses relate to Class O rated insulation. The thicknesses may vary for other ratings

2420 PROTECTION AGAINST FREEZING - MINERAL WOOL:

Outside diameter of pipe (mm)	Indoor condition where freezing might occur	Outdoor condition where freezing might occur
	Thickness of mineral wool insulation (mm)	
Copper pipe		
15	-	-
22	20	50
28	20	25
35	20	20
42	20	20
54	20	20
76	25	25
108	25	25
Steel pipe		
21	40	-
27	20	45
34	20	25
42	20	20
48	20	20
60	20	20
76	25	25
89	25	25

Indoor condition is for ambient air temperature of -6°C, permitted ice formation of 50%

Outdoor condition is for ambient air temperature of -10°C, permitted ice formation of 50%

2430 PROTECTION AGAINST FREEZING - PHENOLIC FOAM:

Within the scope of BS 5422 table 23:

Outside diameter of steel pipe (mm)	Indoor condition where freezing might occur	Outdoor condition where freezing might occur
	Thickness of closed cell phenolic foam (mm)	
15	30	70
20	20	50
25	20	20
32	20	20
40	20	20
50	20	20
65	20	20
80	20	20

Indoor condition is for ambient air temperature of -6°C, permitted ice formation of 50%.

Outdoor condition is for ambient air temperature of -10°C, permitted ice formation of 50%

Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter

2440 PROTECTION AGAINST FREEZING - CLOSED CELL NITRILE RUBBER:

Outside diameter of steel pipe (mm)	Indoor condition where freezing might occur	Outdoor condition where freezing might occur
	Thickness of closed cell nitrile rubber (mm)	
15	57	-
20	25	51
25	13	32
32	13	19
40	13	13
50	13	13
65	13	13
80	13	13
Flat surfaces	13	13

Indoor condition is for ambient air temperature of -6°C, permitted ice formation of 50%

Outdoor condition is for ambient air temperature of -10°C, permitted ice formation of 50%

Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter

2450 ENVIRONMENTAL THICKNESS ON WARM AIR DUCTWORK:

Thermal Conductivity of Insulating Material 0.021 W/mK at Mean Temperature	Maximum Permissible Heat Loss
Thickness of Insulation (mm) with Low Emissivity Facing E=0.05: 20	16.34
Thickness of Insulation (mm) with Low Emissivity Facing E=0.44: 25	16.34
Thickness of Insulation (mm) with Low Emissivity Facing E=0.90: 25	16.34

2456 ENVIRONMENTAL THICKNESS ON DUCTWORK, BUILDING REGULATIONS:

Environmental insulation thickness for ductwork, in accordance with the requirements of the Building Regulations (England and Wales) Part L2 approved documents, and the calculation methods given in BS EN ISO 12241:

Application	Heated duct	Dual purpose	Cooled duct
Environmental thickness of mineral wool insulation (mm)	40	50	50
Environmental thickness of phenolic foam insulation (mm)	25	35	35
Environmental thickness of nitrile rubber insulation (mm)	40	62	62

The above thicknesses for nitrile rubber insulation relate to Class O rated insulation. The thicknesses may vary for other ratings

2460 CONDENSATION CONTROL ON CHILLED AIR DUCTWORK - MINERAL WOOL:

Minimum air Temperature inside duct °C	Thermal conductivity of 0.035 W/mK at a mean temperature of 10°C Surface coefficients		
	Low (0.05)	Medium (0.44)	High (0.90)
	Thickness of mineral wool insulation (mm)		
15	25	25	25
10	50	25	25
5	65	40	25
0	90	50	30

2470 CONDENSATION CONTROL ON CHILLED AIR DUCTWORK - PHENOLIC FOAM:

Minimum insulation thickness for condensation control on ductwork carrying chilled air in ambient conditions. Indoor still air temperature 25°C, relative humidity 80%, dew point temperature 21.3°C:

Minimum air temperature inside duct °C	Thermal conductivity of 0.021 W/mK at a mean temperature of 10°C Surface coefficients		
	Low (0.05)	Medium (0.44)	High (0.90)
	Thickness of phenolic foam insulation (mm)		
15	20	20	20
10	30	20	20
5	40	20	20
0	50	30	20

2475 CONDENSATION CONTROL ON CHILLED AIR DUCTWORK - CLOSED CELL PVC NITRILE FOAM:

Minimum insulation thickness for condensation control on ductwork carrying chilled air in ambient conditions. Indoor still air temperature 25°C, relative humidity 80%, dew point temperature 21.3°C:

Minimum air temperature inside duct °C	Thermal conductivity of 0.036 W/mK at a mean temperature of 10°C. Surface coefficients	
	(0.7)	(0.9)
	Thickness of PVC Nitrile foam insulation (mm)	
	10	8
10	16	12
5	19	16
0	25	25

3010 GENERAL:

Install insulation in accordance with BS 5970

Carry out thermal insulation work using one of the scheduled firms employing skilled craftsmen conversant with class of work

Do not apply thermal insulation until installation has been fully tested and all joints proved sound

Ensure all materials are kept dry

Ensure all pipework surfaces are dry before the installation of thermal insulation

Insulate each unit separately. Do not enclose adjacent units together

Ensure there is clearance between insulated pipes

Application

Apply insulants, facings, coatings and protection strictly in accordance with manufacturer's instructions

Finish:

- Neatly finish joints, corners, edges and overlaps and, where possible, arrange overlaps to fall on blind side. Ensure overlaps are neat and even and parallel to circumferential and longitudinal joints

3020 INSTALLATION OF FOIL FACED MINERAL WOOL INSULATION ON PIPEWORK:

Ensure joints are close butted together. Secure overlaps with adhesive or matching class 'O' tape, a minimum of 50mm wide, on both longitudinal and circumferential butt joints. Insulate fittings to same standard as adjacent pipework and use mitred segments where necessary, taped as above

Where a vapour seal or fibre containment is required tape exposed insulation membrane and return to pipe surface

Where insulation abuts pipe support inserts that have integral vapour barriers seal using class 'O' foil tape to continue vapour barrier or containment

3030 INSTALLATION OF FOIL FACED PHENOLIC FOAM INSULATION ON PIPEWORK:

Ensure joints are close butted together. Secure overlaps with adhesive or matching class 'O' tape, a minimum of 50mm wide, on both longitudinal and circumferential butt joints. Insulate fittings to same standard as adjacent pipework and use mitred segments where necessary, taped as above

3050 INSTALLATION OF CLOSED CELL NITRILE RUBBER INSULATION ON PIPEWORK:

Install closed cell nitrile rubber in accordance with manufacturer's recommendations
Check installation procedure when closed cell nitrile rubber is to be installed on stainless steel pipework

3060 INSTALLATION OF FOIL FACED RIGID OR SLOTTED PHENOLIC INSULATION ON DUCTWORK:

Secure the insulation with adhesive in accordance with manufacturer's recommendations
Use insulation hangers that are fit for purpose and in accordance with thermal insulation and insulation hanger manufacturers
Cut slabs so that the top and bottom pieces overlap the sides. Seal joints and pin penetrations using 100mm wide class 'O' aluminium foil tape
Where cut outs for test holes, etc occur tape over insulation membrane and return to the duct surface
Where insulation abuts duct support inserts that have integral vapour barriers seal using class 'O' foil tape to continue vapour barrier

3070 INSTALLATION OF FOIL FACED FLEXIBLE DUCTWORK INSULATION:

Secure the insulation with adhesive in accordance with manufacturer's recommendations
Use insulation hangers spaced at maximum 300mm centres on the underside of rectangular and flat oval ducts
Seal joints and pin penetrations using 100mm wide class 'O' aluminium foil tape. Where cut outs for test holes, etc occur tape over insulation membrane and return to the duct surface
Where insulation abuts duct support inserts that have integral vapour barriers seal using class 'O' foil tape to continue vapour barrier

3080 INSTALLATION OF FOIL FACED LAMELLA ON DUCTWORK:

Secure the insulation in accordance with manufacturer's recommendations
Use insulation hangers spaced at maximum 300mm centres on the underside of rectangular and flat oval ducts
Seal joints and pin penetrations using 100mm wide class 'O' aluminium foil tape. Where cut outs for test holes, etc occur tape over insulation membrane and return to the duct surface
Where insulation abuts duct support inserts that have integral vapour barriers seal using class 'O' foil tape to continue vapour barrier

3090 INSTALLATION OF INSULATION ON TANKS:

Fit insulation so that two opposite pieces overlap the sides. Bond insulation to the tank with adhesive, applied in accordance with the manufacturer's recommendations. Closely butt together all slabs and seal joints with a matching self-adhesive tape 100mm wide

3100 INSTALLATION OF MINERAL WOOL INSULATION ON VESSELS:

Cut Lamella to length to wrap around duct with an additional 75mm to form an overlap. Remove insulation from facing of overlap together with dust, and seal overlap with adhesive in accordance with manufacturer's instructions. Butt joints closely together and seal with matching self-adhesive tape at least 100mm wide

3110 INSTALLATION OF PHENOLIC FOAM INSULATION ON VESSELS:

Use pre-formed segments or pre-slotted foil faced insulation to fit the diameter of the vessel, laid with staggered joints. Vapour seal the joint faces. Use jointing compound to fill and seal joints around protrusions

Do not use wire to secure insulation

Secure insulation segments up to 3500mm outside insulation diameter with filament tape 38mm wide at 300mm centres

Secure insulation segments over 3500mm outside insulation diameter with aluminium banding

Finish as manufacturer's recommendations

3120 INSTALLATION OF POLYISOBUTYLENE (PIB) PROTECTION:

Wrap pipework and fittings, ductwork or tanks and vessels with PIB sheeting lapped at every joint by at least 50mm. Solvent weld joints and support with banding in accordance with manufacturer

Arrange joints to shed water and prevent the ingress of water

3125 INSTALLATION OF MULTI-LAYERED LAMINATE:

Install laminated foil/film protection, in accordance with manufacturer's instructions. Ensure all surfaces are dry and clean, free from dust, oil and grease/silicone.

Arrange joints to give water shed with the lap facing down.

3130A INSTALLATION OF SHEET METAL FINISH ON PIPEWORK:

Secure insulation with metal bands at each end of section and at maximum centres of 450mm. Form sheet metal to fit tightly over the outer circumference of insulation with a longitudinal overlap of at least 40mm. Secure the outer part of overlap with self tapping screws or rivets at centres of not more than 150mm. Not on pipes with vapour barrier; or metal bands of same material

Ensure circumferential overlaps are at least 50mm, secured with self tapping screws or rivets

Make provision to accommodate expansion and contraction at intervals. Ensure all joints are lapped to shed liquids and seal all joints exposed to weather or spillage
Cover all bends and fittings with matching sheet metal, tailored to fit and sealed as appropriate. Fit pre-insulated, purpose-designed boxes to valves, flanges, etc

3140A INSTALLATION OF SHEET METAL FINISH ON DUCTWORK, TANKS AND VESSELS:

Form sheet metal to fit tightly over the insulation with a longitudinal overlap of at least 40mm. Secure the outer part of overlap with self tapping screws or rivets at centres of not more than 150mm. Not on vapour sealed ducts; or metal bands of same material

Ensure circumferential overlaps are at least 50mm, secured with self tapping screws or rivets

Make provision to accommodate expansion and contraction at intervals. Ensure all joints are lapped to shed liquids and seal all joints exposed to weather or spillage. Cover all bends and fittings with matching sheet metal, tailored to fit and sealed as appropriate

3170 INSTALLATION OF ALUMINIUM SHEETING PROTECTION:

Secure lapped joints (at least 40mm) by means of pop rivets at a maximum spacing of 150mm. For cold piping use matching aluminium straps at maximum spacing of 225mm. On piping operating below ambient temperature seal all joints against moisture. For external use make joints shed water and use sheets with treated surface.

Where 'lockform' seams are used submit proposals for dealing with surfaces curved in three dimensions

3180 INSTALLATION OF ALUMINIUM-ZINC COATED STEEL PROTECTION:

Install aluminium-zinc coated steel protection, in accordance with manufacturer's instructions

3195 INSTALLATION OF LAMINATED FOIL/FILM PROTECTION:

Install laminated foil/film protection, in accordance with manufacturer's instructions

Ensure all surfaces are dry and clean, free from dust, oil and grease/silicone

Arrange joints to give a water shed with the lap facing down

3210 FLANGES AND VALVES:

Cut back to allow removal of bolts and nuts, finish with neat bevel or use end caps

Where boxes are used fit over insulation on adjacent piping

Ensure operation of valve remains unimpaired with box in place

3230A INSTALLATION WHERE INSULATION IS CARRIED THROUGH PIPELINE SUPPORT:

For load bearing insulation, carry through insulation and finish

For non-load bearing insulation on hot pipework close butt to a section of load bearing finished material 100mm long

Up to 120°C, close butt to a high density phenolic pipe support

Up to 120°C, close butt to a section of load bearing calcium silicate material 100mm long

For non-load bearing insulation on cold pipework, close butt to high density phenolic foam pipe supports. Ensure the vapour barrier is maintained

3230B INSTALLATION WHERE CLOSED CELL INSULATION IS CARRIED THROUGH PIPELINE SUPPORT:

For load bearing insulation, carry through insulation and finish

For non-load bearing insulation on hot pipework up to 120°C, close butt to a high density phenolic or polyisocyanurate pipe support

For non-load bearing insulation on cold pipework, close butt to high density phenolic foam pipe supports

Ensure the vapour barrier is maintained

3250 INSTALLATION WHERE INSULATION IS CARRIED THROUGH DUCTWORK SUPPORT:

Provide insulation between duct and support using high density phenolic foam strips. Butt insulation to spacer and carry over finish by 40mm and tape joint. Provide a sheet metal protecting sleeve. Load bearing materials must have a suitable compressive strength for the applied load

3260 LIQUID VAPOUR BARRIERS:

Apply vapour seal solution evenly by brush in accordance with manufacturer's instructions - use solution which dries to a colour distinctive from insulating material

3270 INTEGRITY OF VAPOUR BARRIERS:

Where a vapour barrier is indicated ensure its integrity throughout. Repair immediately any damage to vapour barriers and where such barriers have been applied off site, repair to manufacturer's instructions. Where aluminium sheeting is used for protection, submit proposals for securing sheeting without impairing the integrity of the vapour seal for approval

IDENTIFICATION**1000 GENERAL****1010 REQUIREMENTS:**

Identify all pipework, ductwork, equipment, appliances and ancillaries comprising the various systems

1020 NEW SYSTEMS:

Comprehensively label and colour code throughout works as indicated

1030 EXISTING SYSTEMS:

Where identification details are incompatible with those required for new systems, obtain approval to mode of cross referencing

1040 COLOURS:

As indicated to colour ranges given in BS 381C and BS 4800

1045 PERFORMANCE AND DURABILITY:

Ensure durability of identification for safety purposes is to BS ISO 17398

2010 PIPEWORK IDENTIFICATION:

Standards - Colour code and label to BS 1710

Primary Identification

Apply colour bands, 300mm wide, to each pipe at least once in every room or enclosed area

At intervals not exceeding fifteen metres

At every junction

At every valve

At every inspection and access position into service shafts, false ceilings, bulkheads etc

Secondary Identification

Apply colour bands, 50mm wide, and superimpose a legend identifying circuit, direction of fluid or gas flow, nominal pipe bore and, where appropriate, fluid or gas pressure

Legends

Apply to colour bands by transfers of an approved type

2020 DUCTWORK IDENTIFICATION:**Standards**

Generally colour code and label to HVCA Specification DW 144 (Appendix B)

Primary Identification

Apply colour bands, 300mm wide, to each duct at least once in every room or enclosed area

At intervals not exceeding fifteen metres

At every junction

At every damper

At every inspection and access position into service shafts, false ceilings, bulkheads etc.

Secondary Identification

For ducts with longest side or diameter up to and including 225mm

Paint colour bands 50mm wide and superimpose legends

For ducts with longest side or diameter over 225mm

Paint or apply transfers to identification triangles, or triangular plates

Superimpose or incorporate legends

Triangular Plates

Attach to buckle bands or stool pieces and fix to ducting, with apex indicating direction of airflow. Submit details of plates and fixings for approval before painting and marking

Use equilateral triangle of side 150mm minimum

Legends

Apply transfers of an approved type to colour bands or triangles or triangular plates

Identify floor and space served, associated equipment reference and direction of airflow

2030B PLANT AND EQUIPMENT IDENTIFICATION, LAMINATED PLATES:**Standards**

Identify each item of equipment by name and, where appropriate, by agreed reference characters. Provide colour identification as called for in work sections and, in all cases, colour fire fighting equipment red

Identification Colours:

- Use primary and secondary identification colours of associated system

Plates:

Use rectangular metal or laminated plastic, securely fixed to each item of equipment

Lettering:

- Laminated plates, multi-coloured with outer layer removed for lettering

Legends:

- Engrave plates with an approved text. Incorporate operating duty of equipment where this is not incorporated in other labelling

2040 VALVE AND COCK IDENTIFICATION:

Standards:

- Identify each valve, cock, stop valve, air vent, drain cock etc. with disc engraved with numerical reference. Except where exposed in occupied areas

Identification Colours:

- Use primary and secondary identification colours of associated system for painted or self colour discs

Discs:

- Securely attach metal or laminated plastic discs, minimum diameter 35mm, to each item
- Legends:
- Engrave discs with permanent characters, minimum height 6mm
- Incorporate in operating instructions relating to regulating valves and flow measuring equipment, details of flow rate, pressure differential and setting, as appropriate

2070 AIR VOLUME REGULATING AND CONTROL DAMPER IDENTIFICATION:

Standards:

- Identify each regulating and control damper. Except where exposed in occupied areas. On ductwork dampers, clearly indicate commissioning set point
- Identification colours
- Use primary and secondary identification colours of associated system for painted or self colour discs

Discs:

- Securely attach metal or laminated plastic discs, minimum diameter 35mm, to each item

Legends:

- Engrave discs with permanent characters, minimum height 6mm

2080 INSTRUMENT IDENTIFICATION:

Standards:

- Identify each instrument by name and, where appropriate, by agreed reference characters

Plates:

- Use rectangular metal or laminated plastic, securely fixed to each instrument

Legends:

- Engrave plates with an approved text

2090 DANGER AND WARNING NOTICES:

Hazardous Systems

Colour code and label hazardous systems and equipment to requirements of Health and Safety Executive guidance notes

2100A SYSTEM IDENTIFICATION INSTALLATION CHARTS, PERSPEX GLAZED FRAME:

System Schematics:

- Supply and fix a referenced schematic diagram (or diagrams) of all systems as installed, including equipment and ancillary schedules. Show scheduled information on diagram
- Identify all items by appropriate reference characters

Control Schematics:

- Supply and fix a referenced schematic diagram (or diagrams) of all control systems as installed, including equipment and ancillary schedules. Show scheduled information on diagram
- Identify all items by appropriate reference characters

Location:

- Fix in each boiler house, calorifier room, plant room or equipment room

Finish:

- Perspex sheet glazing with surrounding frame and mounting attachments

2100C SYSTEM IDENTIFICATION INSTALLATION CHARTS, PLASTIC ENCAPSULATED:**System Schematics:**

- Supply and fix a referenced schematic diagram (or diagrams) of all systems as installed, including equipment and ancillary schedules. Show scheduled information on diagram. Identify all items by appropriate reference characters

Control Schematics:

- Supply and fix a referenced schematic diagram (or diagrams) of all control systems as installed, including equipment and ancillary schedules. Show scheduled information on diagram. Identify all items by appropriate reference characters

Location:

- Fix in each boiler house, calorifier room, plant room or equipment room

Finish:

- Plastic encapsulated chart

3.33 VIBRATION AND NOISE**1000 GENERAL****1010 DESIGN INTENT:**

Supply equipment indicated to ensure that vibration from equipment is not transmitted to building, other supporting structure, pipework or ductwork.

All information regarding sound power levels of equipment shall be submitted to the Consulting Engineer prior to the ordering of the equipment

The sub contractor shall include for all necessary vibration and noise absorption materials as indicated on the drawings and also any additional materials to ensure that the following is achieved:

- a) Airborne noise in occupied areas and areas outside the building are kept within acceptable levels

- b) Vibration generated by plant items is kept to within acceptable levels
- c) Break-out noise from fans and equipment is kept within an acceptable level

1020 SPRING ANTI VIBRATION MOUNTINGS:

Select spring mounts with an overload capacity of 50%, for metal springs the outside diameter should be at least 75% of operating height. Permanently identify individual mounts with their load capacity

1040 LOCKING FACILITY:

Where indicated, provide lockable levelling device

2020A SYNTHETIC RUBBER TURRET COMPRESSION MOUNTINGS:

Provide turret compression mountings fabricated from synthetic rubber between two steel plates

Protect the metal from corrosion by painting and fix friction pads to top and bottom. Provide bolt holes to allow fixing

2020B NEOPRENE TURRET COMPRESSION MOUNTINGS:

Provide turret compression mountings fabricated from neoprene between two steel plates

Protect the metal from corrosion by painting and fix friction pads to top and bottom

Provide bolt holes to allow fixing

2030 SPRING COMPRESSION MOUNTINGS:

Provide spring compression mountings comprising high strength low stress helical spring capped with steel pressure plate, on resilient base pad, mounted on pre-drilled base for bolting down, and enclosed with cap. Protect metal from corrosion

2040 CAPTIVE SPRING MOUNTINGS:

Provide captive spring mountings comprising high strength low stress helical spring designed to achieve horizontal and vertical snubbing. Mount spring on pre-drilled base plate for bolting down and protect against corrosion. Supply complete with levelling screw

2060 SPRING COMPRESSION HANGERS:

Provide spring compression hangers comprising high strength low stress helical spring capped with steel pressure plate, on resilient base pad, mounted within hanger box
Construct hanger box from steel (minimum thickness 1.6mm) complete with hole for suspension rod and enlarged lower hole for drop rod to equipment

2070A SYNTHETIC RUBBER HANGERS, COMBINED TURRET/SPRING COMPRESSION:

Provide turret/spring compression hangers with turret fabricated from synthetic rubber and high strength low stress helical spring capped with steel pressure plate, on resilient base pad, incorporated within hanger box
Construct hanger box from steel (minimum thickness 1.6mm) complete with hole for suspension rod and enlarged lower hole for drop rod to equipment

2070B NEOPRENE HANGERS, COMBINED TURRET/SPRING COMPRESSION:

Provide turret/spring compression hangers with turret fabricated from neoprene and high strength low stress helical spring capped with steel pressure plate, on resilient base pad, incorporated within hanger box
Construct hanger box from steel (minimum thickness 1.6mm) complete with hole for suspension rod and enlarged lower hole for drop rod to equipment

2080 HORIZONTALLY RESTRAINED SPRING MOUNTINGS:

Provide horizontally restrained spring mountings comprising high strength low stress helical spring capped with steel pressure plate, on resilient base pad, mounted within hanger box
Construct hanger box from steel (minimum thickness 1.6mm) complete with holes for installing across connection. In addition supply synthetic rubber or neoprene snubber as a horizontal buffer

2100 VIBRATION ISOLATION HOSES:

Provide flexible hose couplings for connecting pipework comprising nylon fabric or steel mesh carcass with waterproof cover and internal lining of material to suit fluid conveyed, temperatures and pressures indicated

2120B MINERAL FIBRE PACKING PIPE WALL AND RISER SEALS:

Provide pipe sleeves, minimum length 300mm, with minimum 52mm mineral fibre packing lining bonded internally

3040 HORIZONTALLY RESTRAINED SPRING MOUNTINGS:

Ensure snubbers for limiting excessive movement are installed out of contact during normal operation

3.34 FIXING TO BUILDING FACBIC

1000 GENERAL

1010 PREPARATION:

Mark-out, set-out and firmly fix all equipment, components and necessary brackets and supports

1020 MANUFACTURER'S DRAWINGS:

Use manufacturer's drawings and templates for purposes of marking and setting out

1030 FIXINGS:

Ensure structure and fixings are suitable for items to be fixed

1040 LOADING DETAILS:

Provide loading details for all fixing types

1050 BUILDING-IN BY OTHERS:

Provide all necessary assistance to enable any item of building-in type to be built in by others

1060 SIZE OF FIXING:

Use largest size of bolt, screw or other fixing permitted by diameter of hole in item to be fixed

1070 GREASING OF FIXINGS:

Ensure all bolts, screws or other fixings used are greased or lubricated in accordance with manufacturer's instructions

2010 STANDARDS:

Ensure that fixings such as expanding anchors are tested for tensile loading in accordance with BS 5080-1

2020 PLUGS:

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
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

2030 SCREWS:

Use screws to BS 1210. Generally use sherardized steel wood screws for fixing to concrete, brickwork or blockwork

In damp or exposed situations use greased stainless steel screws

2080 NON-PENETRATIVE SUPPORT SYSTEMS FOR ROOF MOUNTED EQUIPMENT:

Obtain approval prior to using non-penetrative support systems for roof mounted equipment

3010 DRILLING:

Drill holes squarely. Use drills of requisite size and depth, and appropriate to fabric. Do not flame-cut holes in metal work

3050 FIXING TO TIMBER RAILS:

Fix equipment, brackets and supports by drilling hole through timber rail and fixing with bolt, back plate, washer and loose nut

3060A FIXING TO HOLLOW STUD/TILE/BLOCK WALLS:

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

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

3070A FIXING TO CONCRETE, BRICKWORK OR BLOCKWORK:

Fix equipment, brackets and supports using wood screws in plugs or, as appropriate, drill holes and fix using steel bolts of grouted bolt type or expanding bolt type fixing

3080A FIXING TO METALWORK:

Fix equipment, brackets and supports by drilling holes and fixing using set screws or bolts complete with washers, shakeproof washers and loose nuts

3090A FIXING TO STRUCTURAL STEELWORK AND CONCRETE STRUCTURES:

Provide manufacturer's information on recommended fixing. Obtain approval for any fixing to structure steel work and concrete structures

Generally use proprietary fixings to structural steelwork and concrete structures

Obtain approval to cut holes in structural steelwork or concrete structures or weld to structural steelwork

3.35 PAINTING AND ANTI CORROSION TREATMENTS

1000 GENERAL:

2010A PAINT MATERIALS:

Use the following materials as appropriate

Solvent borne priming paint to BS 7956 for bare woodwork

Red oxide priming paint for bare iron and steelwork

Zinc Chromate priming paint for bare ferrous and non-ferrous metals

Calcium Plumbate priming paint to BS 3698 for galvanized steel or composite wood/metal components

Undercoating paint for previously primed or painted surfaces before the application of finishing coats

Gloss finishing paint for previously primed or painted/undercoated surfaces

Epoxy resin paint for specialist coatings requiring resistance to acids, alkalis, oils, solvents, abrasion or high humidity

Aluminium paint to BS 388 for structural steelwork, storage vessels, heated metallic surfaces and similar applications where moisture and heat resistant properties are required

Cold galvanizing paint for making good damage to previously galvanized surfaces and protection to galvanized materials modified during installation

Zinc-rich metallic to BS 4652 for bare iron and steelwork where electrical conductivity has to be assured

Black tar-based paint to BS 1070 for moisture resistant protection to metal surfaces where decorating appearance is not important

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

Bitumen based coatings for cold application to BS 6949 not to be used in contact with potable water

2020 PAINT QUALITY:

Ensure paints used are of quality and type to suit application and that:-

Primers have good adhesion, covering power, rust-inhibiting and grain filling properties

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

3020 WEATHER AND OTHER CONDITIONS:

Do not apply paints where weather, temperature, humidity or other conditions may have a damaging effect upon finish or paint

3030A CLEANING AND PREPARING STEEL SURFACES FOR PAINTING:

Ensure metal surfaces are thoroughly cleaned, all mill and weld scale removed and finally degreased. Clean steel surfaces in accordance with BS EN ISO 8503 and prepare surfaces for painting in accordance with BS EN ISO 4618

3030B CLEANING AND PREPARING SURFACES FOR PAINTING:

Ensure metal surfaces are thoroughly cleaned, all mill and weld scale removed and finally degreased. Prepare surfaces for painting in accordance with BS EN ISO 4618

3040 APPLICATION OFF-SITE:

Wherever possible ensure paint finishes applied by component manufacturers are spray applied

3050 APPLICATION:

Apply paint evenly and ensure finish shows no excessive brush marks, grinning, runs, sagging, ropiness or other application defects

3060 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

3070 PROTECTION OF BRIGHT MACHINE PARTS:

Apply a protective coating to all bright machined parts before despatch from works

Do not remove protective coatings unless required for installation, testing or commissioning purposes and in such cases reinstate upon completion

Repair any damaged protective coating or bright machined part, or where necessary replace damaged component

Use and apply metal coatings in accordance with manufacturer's instructions

Complete where possible all welding, drilling, bending and other work before metal coating

3.36 ELECTRICAL REQUIREMENTS FOR MECHANICAL SERVICES**Y60 CONDUIT AND CABLE TRUNKING****1000 GENERAL****1010 STANDARDS:**

Provide conduit and cable trunking in accordance with the relevant British Standards and in particular the requirements of BS 7671 Requirements for Electrical Installations (The IET Wiring Regulations).

Y61 HV/LV CABLES AND WIRING

1000 GENERAL

1010 CABLE MANUFACTURER:

Use new cables, delivered to site with seals intact, manufactured not more than one year prior to delivery, labelled with manufacturer's name, size, description, BS number, classification, length, grade and date of manufacture

Y63 SUPPORT COMPONENTS – CABLES

1000 GENERAL

1010 APPLICATION:

Cables referred to in this section are only those types that can be installed without further mechanical protection

Y72 CONTACTORS AND STARTERS

1000 GENERAL

1010 A ELECTRICAL SUPPLY:

Ensure all electrical equipment supplied and installed is suitable for power supply indicated to BS 7697

1010A 3 PHASE SUPPLY:

Ensure all electrical equipment supplied and installed is suitable for 3 phase power supply to BS 7697

1010B SINGLE PHASE ELECTRICAL SUPPLY:

Ensure all electrical equipment supplied and installed is suitable for single phase power supply to BS 7697

2130A MOTOR STARTERS - MOTORS BELOW 0.37 KW:

Provide fuses or circuit breakers for motors below 0.37 kW

2130B MOTOR STARTERS - MOTORS OF 0.37KW AND ABOVE:

Provide starters incorporating overcurrent protection for motors of 0.37kW and above
Provide starter with manual reset, adjustable, inverse time delay, and ambient temperature compensated thermal overcurrent release to BS EN 60947-4-1. Ensure overcurrent release is compatible with starting, accelerating and running characteristics of motor, starter and driven machine combination. Use phase unbalance protection on three phase equipment

2140 CURRENT LIMITING MOTOR STARTERS:

Use static type thyristor voltage control starter to provide reduced current starting. Provide adjustable ramp times
Provide contactor for switching and disconnect for isolation
Provide details of harmonic distortion content prior to ordering

2150 DIRECT-ON-LINE MOTOR STARTERS:

Use direct-on-line starter to BS EN 60947-4-1, with single phase motors and three phase motors

2160 STAR DELTA MOTOR STARTERS:

Use star delta starter to BS EN 60947-4-1 with three phase motors
Incorporate adjustable time delay contactor relays, to control star delta changeover, ensuring electrical endurance compatible with starter contactors. Ensure starting sequence activated on voltage restoration

2170A AUTO-TRANSFORMER MOTOR STARTERS:

Use auto-transformer starter to BS EN 60947-4-1 with three phase motors
Provide 2 step closed transition auto transformers suitable for 3 operating cycles per hour
Provide auto transformers with three tapplings for selection of motor starting voltage. Arrange tapplings to limit motor starting current to 80 per cent, 65 per cent and 50 per cent of full voltage starting current
Incorporate adjustable time delay contactor relays, to control automatic changeover from selected reduced voltage to full voltage, having an electrical endurance compatible with starter contactors. Ensure starting sequence activated on voltage restoration

2180A STATOR ROTOR MOTOR STARTERS:

Use stator rotor starter to BS EN 60947-4-1 with three phase motors
Provide starter resistors suitable for indicated operating cycles per hour
Incorporate adjustable time delay contactor relays, to control starter resistor short circuiting contactors, having electrical endurance compatible with starter contactors. Ensure starting sequence activated on voltage restoration

2190A CONTROL PANEL INVERTOR MOTOR STARTERS:

Supply inverters to control speed of standard AC Squirrel cage motors

Inverter type - digital PWM

Location - control panel

Control range - 0.5 to 120 Hz

Power factor - 0.95 or better

Starting current - not to exceed 1 x FLC

Characteristics:

- Ensure acceleration and deceleration ramps are independently adjustable
- Allow connection to a turning motor without braking to a standstill
- Allow connection to a reverse windmilling fan without causing tripping and return fan to correct speed. Ensure inverters require no additional means for starting. Supply inverters that do not require electrical matching to motor. Ensure inverters are capable of running motors in parallel
- EMC characteristics to BS EN 61800

Mains interruption:

- Ensure inverter does not cause tripping through a mains interruption of 200 msec

Protection:

- Ensure inverter incorporates the following protection to cause electronic shut down without operating circuit protective devices
- Motor phase to phase fault; motor phase to earth fault; overvoltage; undervoltage; inverter overheat; motor overheat; loss of control signal; loss of auxiliary control voltage; current limit.
- Inverter controls - Local/remote facility

Display:

- Make provision for inverter to display externally, external and internal faults following a failure. Show 1st, 2nd and 3rd up sequential faults.
- Provide digital readout to show output frequency Hz; reference 1 (Hand); reference 2 (Auto); motor current (% or Amps); fault memory
- Provide volt free remote signalling contacts to indicate common fault; running/stopped conditions; healthy/tripped conditions
- Ensure parameters can be set and fault memory interrogated with door closed, and without additional instrumentation

2200 AUTOMATIC CHANGEOVER FOR RUN/STANDBY DUTY - SINGLE POWER SUPPLY:

Fit a control switch to starter enclosure arranged to select either motor for "run" or "standby" duty. Indicate selection of respective motor by illumination of indicator lights on starter enclosure

Provide facilities for connection of remote indicator lights to indicate selection/operation of system and for connection of a system malfunction audible alarm where indicated

Arrange for selected "run" duty motor to operate in response to system controls, and in event of operation of duty motor starter overcurrent trip, for automatic changeover to "standby" motor

Control power supply to starter by an air break isolating switch interlocked with starter enclosure access door

3010 INSTALLATION:

Install control panels, motor control centres, contactors and starters in accordance with BS EN 60947 and manufacturer's recommendations

Y74 ACCESSORIES FOR ELECTRICAL SERVICES**1000 GENERAL:****1010 APPLICATION:**

Supply fixed electrical wiring accessories for use with fixed and portable peripheral equipment using either power or signalling cables

Y80 EARTHING AND BONDING**1000 GENERAL****1010 MATERIALS GENERALLY:**

Use materials and installations methods in accordance with BS EN 62305, BS 7671, BS 7430, Electricity Safety, Quality and Continuity regulations and local electricity supply authority requirements as appropriate.

Y92 MOTOR DRIVES – ELECTRIC**1000 GENERAL****1040A MANUFACTURER FITTED SURGE SUPPRESSORS:**

Supply surge suppressors to star connected motors and to all motors subject to star-delta starting to limit peak voltage to 1200 volts. Fitted by manufacturer

1050A MANUFACTURER FITTED TRANSIENT SUPPRESSORS:

Supply transient suppressors in the form of resistor and capacitor networks across the starter contactor coils. Fitted by manufacturer

2010A STANDARD OPERATING CONDITIONS:

Ensure motors, starters and ancillary equipment are suitable for operation at full capacity at heights above sea level not exceeding 1000m, with air cooling at an average temperature over 24 hours not exceeding 35°C dry bulb with maximum conditions of 40°C dry bulb and 50% RH

2010B NON STANDARD OPERATING CONDITIONS:

Ensure motors, starters and ancillary equipment are suitable for operation at full capacity at heights above sea level above 1000m, with conditions exceeding 40°C dry bulb and 50% RH

2020 MOTORS - GENERAL: Standard

Use motors which conform to BS EN 60034, as applicable, which operate at lowest possible speed, compatible with performance requirements

Ratings:

- Select maximum continuous rating (MCR) such that driven machine operates at correct speed or speeds at design duty
- When running continuously at design rated duty, the temperature of the motor parts is within limits defined in BS EN 60034-1
- When provided with excess motor current (over-load) protection of thermal overcurrent release type, ensure operation is within tolerances of tripping as defined in BS EN 60947-4-1

Insulation:

- Use motors with Class 130 or 155 to BS EN 60085 insulation, with temperature rise as defined in BS EN 60085.

Conduit entry:

- Fit motor bodies with conduit entry terminal box or cable gland as required, and to suit type and size of cable being terminated.

2025A CLASS 1 MOTOR EFFICIENCY:

Supply a Class Eff 1 High Efficiency Motor (HEM) with a stated efficiency as european motor efficiency classes table as follows:

Power kW	Min Eff Class 2 (%)		Min Eff Class 1 (%)	
	2 Pole	4 Pole	2 Pole	4 Pole
1.1	76.2	76.2	82.2	83.8
1.5	78.5	78.5	84.1	85.0
2.2	81.0	81.0	85.6	86.4
3.0	82.6	82.6	86.7	87.4
4.0	84.2	84.2	87.6	88.3
5.5	85.7	85.7	88.5	89.2
7.5	87.0	87.0	89.5	90.1
11.0	88.4	88.4	90.6	91.0
15.0	89.4	89.4	91.3	91.8
18.5	90.0	90.0	91.8	92.2
22.5	90.5	90.5	92.2	92.6
30.0	91.4	91.4	92.9	93.2
37.0	92.0	92.0	93.3	93.6

45.0	92.5	92.5	93.7	93.9
Power kW	Min Eff Class 2 (%)		Min Eff Class 1 (%)	
	2 Pole	4 Pole	2 Pole	4 Pole
55.0	93.0	93.0	94.0	94.2
75.0	93.6	93.6	94.6	94.7

2025B CLASS 2 MOTOR EFFICIENCY:

Supply a Class Eff 2 High Efficiency Motor (HEM) with a stated efficiency as european motor efficiency class table below:

Power kW	Min Eff Class 2 (%)		Min Eff Class 1 (%)	
	2 Pole	4 Pole	2 Pole	4 Pole
1.1	76.2	76.2	82.2	83.8
1.5	78.5	78.5	84.1	85.0
2.2	81.0	81.0	85.6	86.4
3.0	82.6	82.6	86.7	87.4
4.0	84.2	84.2	87.6	88.3
5.5	85.7	85.7	88.5	89.2
7.5	87.0	87.0	89.5	90.1
15.0	89.4	89.4	91.3	91.8
11.0	88.4	88.4	90.6	91.0
18.5	90.0	90.0	91.8	92.2
22.5	90.5	90.5	92.2	92.6
30.0	91.4	91.4	92.9	93.2
37.0	92.0	92.0	93.3	93.6
45.0	92.5	92.5	93.7	93.9
55.0	93.0	93.0	94.0	94.2
75.0	93.6	93.6	94.6	94.7

2030 SLIDE RAILS:

Fit motors on slide rails or other suitable means of adjustment to facilitate correct alignment and belt tension

2040 PLINTHS:

Where plinths are built in by others, provide all necessary assistance and information

2050A MOTOR RATINGS - UP TO AND INCLUDING 0.75KW:

Single or three phase, totally enclosed, frame cooled or fan cooled. For duty and torque requirements of driven machine

2050B MOTOR RATINGS - ABOVE 0.75KW UP TO AND INCLUDING 4KW:

Three phase, squirrel cage induction type, totally enclosed, frame cooled or fan cooled
To BS EN 60034-5 and BS EN 60034-6 IP44 - IC 01.411

2050C MOTOR RATINGS - ABOVE 4KW SQUIRREL CAGE, DRIP-PROOF:

Three phase, squirrel cage, induction type, drip-proof enclosure. To BS EN 60034-5 and BS EN 60034-6 IP22S - IC 01

2050D MOTOR RATINGS - ABOVE 4KW WOUND ROTOR, DRIP PROOF:

Three Phase, wound rotor, slip type, drip-proof enclosure. To BS EN 60034- 5 and BS EN 60034-6 IP22S -IC 01

2050E MOTOR RATINGS - ABOVE 4KW SQUIRREL CAGE, TOTALLY ENCLOSED:

Three phase, squirrel cage, induction type, totally enclosed, frame or fan cooled
To BS EN 60034-5 and BS EN 60034-6 IP44 - IC 01.411

2050F MOTOR RATINGS - ABOVE 4KW WOUND ROTOR, TOTALLY ENCLOSED:

Three phase, wound rotor, slip ring type, totally enclosed, fan cooled. To BS EN 60034-5 and BS EN 600346 IP44 - IC 01.411 or IC 01.511 as applicable

2050G MOTOR RATINGS - ABOVE 4KW SQUIRREL CAGE, SMOKE SPILL:

Three phase squirrel cage, induction type for smokespill applications. To BS EN 60034-5 and BS EN 600346 IP55, cooling as applicable

2050H ABOVE 4KW SQUIRREL CAGE, ENERGY EFFICIENT DESIGN:

Three phase, squirrel cage, induction type energy efficient design, totally enclosed, fan cooled to BS EN 60034-5 and BS EN 60034-6 IP55 - IC 01.411

2060A MOTORS - OVER TEMPERATURE PROTECTION, THERMISTORS:

Fit positive temperature coefficient thermistors to BS EN 60034-11. Provide a minimum of 3 PTC thermistors in each motor with 2 ends terminated in motor terminal box clearly and permanently marked

For motors rated between 30kW and 75kW provide a single thermistor in each phase. For motors rated above 75kW provide two thermistors in each phase

Provide control unit to BS EN 60034 to motors fitted with thermistors. Interconnect control unit with thermistors and starter to trip starter when one or all of thermistors detect overheating

2070A INDIRECT DRIVES WITH TOOTHED BELTS:

Belts:

- Use toothed wedge belts to BS 3790. Provide at least two matched belts for any drive, of anti-static type and rated to transmit full machine power with one belt removed

Pulleys:

- Construct pulleys from approved materials and statically balance. Lock close limit bores by keys fitting into machinery shaft keyway

Pulley Adjustment:

- Adjust pulley to give alignment and correct belt tension

2070B INDIRECT DRIVES WITH FLAT BELTS:

Belts:

- Use flat wedge belts to BS 3790. Provide at least two matched belts for any drive, of anti-static type and rated to transmit full machine power with one belt removed

Pulleys:

- Construct pulleys from approved materials and statically balance. Lock close limit bores by keys fitting into machinery shaft keyway

Pulley Adjustment:

- Adjust pulley to give alignment and correct belt tension

2080A DIRECT COUPLED DRIVES:

Use an extended motor shaft coupled to machine or a flexible coupling connecting driving and driven shafts, incorporate suitable arrangements for aligning the two shafts

Mount motors on a substantial mild steel bed plate fixed to machine casing separately supported or supported entirely from the machine casing

2085 VARIABLE SPEED DRIVE:

Use variable speed drive to match design and installed flow volumes

2090A GUARDS:

Totally protect drives and couplings. Fit purpose made guards around all exposed or otherwise accessible drive shafts, pulleys, 'V' belts or couplings

Ensure guards comply with national or local safety codes, acts and bye-laws and incorporate following features

Construction to BS EN ISO 12100 and generally of galvanized steel wire mesh. Stiffening within the guards to ensure rigidity and freedom from vibration

Allowance for prime mover adjustment during belt tensioning procedures. Temporary access to all shafts for use of Tachometer

2100 A MOTOR MOUNTING CLASSIFICATION:

Standard - BS EN 60034-7

Code I classification – IM:

- Alpha code
- B
- V
- Numeric code

Code II classification – IM:

- First numeral
- Second numeral
- Third numeral
- Fourth numeral
- Interpretation table

3.37 TESTING AND COMMISSIONING - GENERAL

The sub contractor shall include and make full allowance for carrying out the balancing, testing and putting in full working order all the installations on the drawings, as described in this specification, and to fully comply with local authority requirements.

Prior to carrying out the commissioning the sub contractor shall submit a full method statement to the Consulting Engineer for approval. The statement shall include proposed techniques and equipment, the approximate order of work and a complete list of target design figures. Upon completion a full set of readings showing comparisons between target figures and actual figures shall be submitted to the Consulting Engineer for comment.

1000 GENERAL**1010 CONDITIONS FOR CLEANING AND CHEMICAL TREATMENT:**

Ensure treatment complies with statutory authority and health and safety regulations

Notify manufacturers and suppliers of equipment of proposed system cleaning and chemical treatment processes

Establish if any manufacturer or supplier of equipment requires any particular cleaning and chemical treatment process due to size of waterways or materials used

All chemicals used are to be compatible with the metallurgy of the systems

1015 METHOD STATEMENT:

Provide a method statement covering the sequence of events, chemicals to be used etc
Statement to be provided at least two months prior to the start of any flushing and/or chemical cleaning works

2010 CLEANING AND CHEMICAL TREATMENT SPECIALIST:

Use a specialist for analysis and for design, supply, installation and operation of any system cleaning and chemical treatment process

2020A MAINS WATER ANALYSIS:

Obtain an analysis of mains water taken from site supply point. Check with local water authority to ensure analysis results are typical for site area and report variances for instruction; or submit a sample of water to water treatment specialist as appropriate
Carry out tests to establish total viable counts and pseudomonas and sulphate reducing bacteria

2030A PRELIMINARY CHECKS:

Prior to carrying out cleaning or chemical treatment process, ensure that all foreign matter is removed

Certified pressure tests have been carried out in the parts of the system to be cleaned.
Carry out further pressure tests on the isolated sections of the system independently

All water used for pressure testing is inhibited

Leave remaining pipework sections full after testing. If on domestic hot and cold water systems immediate use is not anticipated, test with air only

Where there is a risk of freezing inhibited mono-ethylene glycol is used

Circulation has been demonstrated and approval obtained on all parts of the system.

Manipulate and leave fully open all valves other than those used to isolate sections

Carry out balancing and certification after the flushing, cleaning and passivation operations

No damage can occur to any item of plant or equipment due to cleaning and chemical processes

Chemicals used are compatible with system materials

All items of plant and equipment subject to damage or blockage due to cleaning and chemical treatment processes are isolated or removed

Permanent or temporary by-passes are provided as indicated on drawings

Dirt pockets are installed at low points to facilitate solids removal. Supply dirt pockets with drain valves sized to pipework size

All drains provided have been tested and approved and that any pumping equipment associated with the drainage system is fully commissioned

Dead legs, that are more than 3 pipe diameters in length are looped to allow effective cleaning

Strainer baskets and filter media, incorporated within systems, are removed; and where necessary spool or stool pieces are installed

Temporary strainers and filters are installed as required for removal of solids during cleaning and chemical treatment processes

Strainers are clean prior to the start of the cleaning process, throughout the cleaning and on completion

Suitable supply and drainage points are provided with 50mm minimum connections, properly sited and installed, either valved or plugged

All automatic/manual air vents are fully commissioned

All requirements of COSHH regulations are complied with during the chemical cleaning and chemical treatment of the system

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

Comply with Waste Management Duty of Care: A Code of Practice and The Hazardous Waste (England & Wales) Regulations 2005 where appropriate

2040A PROCEDURAL PRECAUTIONS FOR CLEANING AND CHEMICAL TREATMENT:

Carry out tests to ensure that cleaning and chemical treatment processes are operating as required

Carry out tests to ensure that cleaning and chemical treatment processes are operating as required. and detailed in the method statement

Submit all test and sample results for certification and approval

2040B PROCEDURAL PRECAUTIONS FOR CLEANING AND CHEMICAL TREATMENT INCLUDING TAKING SAMPLES:

Take samples during and following chemical treatment and/or cleaning

Submit samples to an independent analyst

Use sterile containers to take samples

Carry out tests to ensure that cleaning and chemical treatment processes are operating as required

Submit all test and sample results for certification and approval

Ensure all samples are witnessed

2060A CHEMICAL INJECTION AND DOSING METHODS FOR CLOSED SYSTEMS:

Method of introducing chemicals

Dosing pots; manually initiated timer controlled dosing; or proportional dosing as appropriate

2060B CHEMICAL CLEANING AND DOSING METHODS FOR OPEN RECIRCULATING SYSTEMS:

Method of introducing chemicals

Chemical dosing for scale and corrosion inhibitors

Continuous; timer controller; or proportional dosing as appropriate

Bleed-off control

Biocide dosing - automatic dosing control

2060C PACKAGED CHEMICAL INJECTION AND DOSING PLANT:

Provide packaged monitoring and treatment plants

2060D DOSING - CLOSED SYSTEMS:

Chemical feed

Provide feeder (dosing pots) with a tundish for filling; separate air vent with discharge tube; drain and isolating valves

Install in each water system a means of taking a sample as follows:- chilled water systems - provide a gate valve and discharge

Heating systems - provide a sample cooler with a copper coil and cooling jacket with cooling water valve and drained to waste

2065 CHEMICALS - DOSING:

Provide biocides effective against Legionella Pnueumophilia, algae, fungi, moulds and slime forming bacteria including pseudomonas and sulphate reducing bacteria

Supply biocides as recommended by water treatment specialist

Incorporate a bio dispersant in the programme to break up and disperse any slime masses, where required

The water treatment specialist shall select the appropriate corrosion inhibitors, to minimise corrosion, and biocides to prevent any proliferation to mild steel, copper and copper alloys

Provide a specific inhibitor to protect aluminium when it is present in the system. The cleaning agent is to be specified by the water treatment specialist

2070A MONITORING:

Provide monitoring system to enable on-line analyses, system alarms and chemical stock levels to be monitored by water treatment specialist

Where indicated, provide facility for system to be monitored by water treatment specialist at remote location

2070B SAMPLING:

Provide testing equipment to carry out tests for all inhibitors used in treatment programme indicated

2070C SAMPLING KITS:

Provide the following test kits as appropriate

Boiler water test kit for steam boilers; conductivity test kit; pH test kit; inhibitor test kit; hardness test kit

Where a softener is installed; chloride level test kit

Install a corrosion test rig to enable corrosion rates to be monitored using corrosion coupons. Bacteriological monitoring with use of dipslides

Log sheets for recording of test results, bacteriological analysis and any actions required or taken

2080A CHEMICAL PROVISION, STANDARD ARRANGEMENT:

Provide consumables for a period of 12 months

Where indicated, provide for supply of chemicals from containers refilled by drumless delivery system

Include for supply of chemicals for all systems using the basis of: open circuit systems operating at 100 % load for 2080 hours per annum

Closed circuit systems make-up 1% system volume/month

3010A FLUSHING:

Carry out flushing of water systems in accordance with BSRIA Application Guide 1/01 Pre-commission cleaning of pipework systems

Section 2 Installation considerations

2.1 Management

2.2 Pipework installation

2.3 Preparation for flushing and cleaning

2.4 Procedure for filling, pressure testing and static flushing

Section 3 System dynamic flushing

C1 Flushing objectives

C2 Dynamic flushing procedure

Inspection and witnessing, as section 1.4

3010B FLUSHING:

All water used for pressure testing, flushing and system filling is of good quality. Leave remaining pipework sections full and treated after pressure testing

Install all necessary pipework ancillaries to enable a specialist to carry out flushing, inspection and witnessing of water systems in accordance with BSRIA application guide AG 1/01. Pre-commission cleaning of pipework systems

Temporary connection from the mains must be in compliance with the Water Supply (Water Fittings) Regulations 1999 and amendment, or by installation of a temporary tank and pump arrangement

Domestic water systems are to be flushed and disinfected in accordance with the requirements of BS 6700 and BS EN 806-4, and to the satisfaction of the local water supply authority

Flush systems using mains water until the water is clear

3030A CHEMICAL CLEANING AND SOLIDS REMOVAL - INHIBITED ACID:

Carry out chemical cleaning procedure in accordance with BSRIA application guide 1/01 pre-commission cleaning of pipework systems

4.1 Introduction**4.2 Cleaning options****4.2.1 Degreasing****4.2.2 Biocide wash****4.2.3 Removal of surface oxides - Inhibited acid cleaning****4.2.4 Effluent disposal/final flushing****4.2.5 Neutralisation****4.2.6 Passivation****4.2.7 Corrosion inhibitor/biocide dosing****4.2.8 Treatment up to system handover****4.3 On-going water treatment**

Inspection and witnessing, as section 1.4

3030B CHEMICAL CLEANING AND SOLIDS REMOVAL - FORMULATED PRODUCTS:

Carry out chemical cleaning procedure in accordance with BSRIA application guide 1/01 pre-commission cleaning of pipework systems

4.1 Introduction**4.2 Cleaning options****4.2.1 Degreasing****4.2.2 Biocide wash****4.2.3 Removal of surface oxides - inhibited acid cleaning****4.2.4 Effluent disposal/final flushing****4.2.5 Neutralisation****4.2.6 Passivation****4.2.7 Corrosion inhibitor/biocide dosing****4.2.8 Treatment up to system handover****4.3 On-going water treatment**

Inspection and witnessing, as section 1.4

3040 STERILIZATION - GENERAL:

After flushing process, carry out sterilization in accordance with BS 6700 and BS EN 806-4

Prior to sterilization ensure each system is flushed, cleaned and drained

Provide temporary connections to system terminal points suitable for introduction of sterilization chemicals and fluids and 22mm minimum valved drain connection on incoming main immediately downstream of mains isolating valve

Fill system with clean, fresh water

3050 STERILIZATION - MAINS WATER SYSTEM:

Carry out the following operations in accordance with BS 6700 and BS EN 806-4

Flush system and introduce sterilisation chemical

Take samples from all sentinel points to ensure correct chlorine concentration

Leave system to stand for period of time indicated

Repeatedly flush system with clean water until all traces of chlorine have been removed - leave system filled

Submit samples to registered laboratory for microbiological analysis and report

Certificate of conformity

Immediately prior to handover, retake samples and submit for analysis and report

Where necessary repeat sterilisation of potable water system immediately prior to handover

3060 STERILIZATION - WATER STORAGE SYSTEMS:

Carry out the following operations in accordance with BS 6700 and BS EN 806-4, and HSE L8 legionnaires' disease - control of legionella bacteria in water systems ACOP and guidance

Carry out operations on all water storage tanks and cisterns, cold and hot. Carry out procedures as for mains water systems

3080 SERVICE VISITS:

Provide monthly service visits for one full year by a fully qualified chemist, to carry out the following:-

- Review water analysis records, correspondence and reports since previous visit
- Test water samples on site for hardness; all inhibitors; dissolved solids; pH; total alkalinity
- Check performance of feeding equipment, softeners, and testing equipment on site
- Submit a written report
- Carry out micro-biological analysis using dipslides special requirements as indicated

3090 DOCUMENTATION:

Provide number of copies as indicated of hard cover binders containing details of:-

- Programme outlines
- Purpose of chemical treatment
- Chemicals used and quantity
- On site testing procedures
- Control limits of tests
- Equipment data and drawings
- Product notes and material safety data sheets for all chemicals used
- Provide a complete training programme for site operatives covering
- Methods of basic water testing
- Explanation of results obtained
- Actions to be taken on test results

COMMISSIONING

1000 GENERAL

2010 PRESSURE TESTING - GENERAL:

Comply with procedures given in HVCA TR/6 Guide to Good Practice for Site Pressure Testing of Pipework. Ensure safety precautions detailed in HSE guidance note GS4 safety in pressure testing are adopted

Provide a blanked connection to accommodate a check gauge in addition to the accurate gauge fitted to section under test

Test concealed or buried pipework before any permanent covering is applied

2010 PRESSURE TESTING - GENERAL:

Advise appropriate personnel, in advance, of the time pressure tests may be witnessed

2020 PRESSURE TESTING - WATER CIRCULATING AND SUPPLY SYSTEMS AND STEAM AND CONDENSE LINES:

Carry out Hydraulic Pressure Testing as described in HVCA TR/6 guide to good practice for Site Pressure Testing of Pipework. Test section by section for one hour, as the work proceeds and prior to application of thermal insulation as follows:

Operating gauge pressure less than 3.5 bar, test gauge one and a half times operating pressure. Operating gauge pressure 3.5 - 7.0 bar, test gauge pressure twice operating pressure

Operating gauge pressure greater than 7.0 bar, test gauge pressure 14.0 bar or one and a half times operating pressure, whichever is the greater

2040 PRESSURE TESTING - WATER MAINS:

Test to Local Authority requirements. Ensure the provisions laid down in HVCA TR/6 Guide to Good Practice for Site Pressure Testing of Pipework for testing underground CWS mains are carried out

2080 PRESSURE TESTING - SOIL, WASTE, VENTILATION, ANTI-SYPHON AND RAINWATER PIPEWORK:

Test section by section as the work proceeds and subsequently on completion with all sanitary fittings fixed and working. Submit systems to two separate tests, air test and hydraulic performance test in accordance with BS EN 12056-2

3020 COMMISSIONING CODES:

Carry out commissioning of installations in accordance with the procedures, checks and tolerances given in the BSRIA application guides for water systems and air systems to achieve the standards set in the CIBSE Commissioning Codes

3030A COMMISSIONING WATER DISTRIBUTION SYSTEMS INCLUDING BSRIA PRE-COMMISSIONING CHECKLIST:

Preliminary checks:

- Carry out checks and procedures as detailed in CIBSE Commissioning Code W
- Ensure system is statically complete as defined in section B4 of BSRIA application guide 2/89 Commissioning of Water Systems in Buildings
- Use pre-commissioning checklist from BSRIA Application guide 2/89

Setting to work and regulation:

- Set to work and regulate water distribution systems in accordance with CIBSE commissioning code W, sections W2 and W3, and sections C3 and C4 in BSRIA application guide 2/89

Measurement:

- Use instruments for measurement detailed in BSRIA application guide 2/89

3040A COMMISSIONING AIR DISTRIBUTION SYSTEMS INCLUDING BSRIA PRE-COMMISSIONING CHECKLIST:

Preliminary checks

Carry out checks and procedures as detailed in BSRIA application guide 3/89 Commissioning of Air Systems in Buildings

Use pre-commissioning checklist in BSRIA application guide 3/89m, Setting to Work Regulation

Set to work and regulate air distribution systems in accordance with CIBSE commissioning code A, section A2, and sections C3, C4 and C5 in BSRIA application guide 3/89

Measurement of air flow

Use instruments for measurement and methods of measurement detailed in BSRIA application guide 3/89 and CIBSE commissioning guide, section A3

3040B COMMISSIONING VAV AIR DISTRIBUTION SYSTEMS INCLUDING BSRIA PRE-COMMISSIONING CHECKLIST:

Preliminary checks

Carry out checks and procedures as detailed in CIBSE commissioning code A, section A1

Ensure system is statically complete as defined in section B4 of BSRIA application guide 3/89 Commissioning of Air Systems in Buildings

Use pre-commissioning checklist in BSRIA application guide 3/89, Setting to Work Regulation

Set to work and regulate air distribution systems in accordance with CIBSE commissioning code A, section A2, and sections C3, C4 and C5 in BSRIA application guide 3/89

For regulation of Variable Air Volume Systems follow routine in BSRIA application guide 1/91

The Commissioning of VAV Systems

Measurement of air flow

Use instruments for measurement and methods of measurement detailed in BSRIA application guide 3/89 and CIBSE commissioning guide, section A3

3060 COMMISSIONING REFRIGERATING SYSTEMS:

Follow the procedures given for use and handling of refrigerants, pressure and leak testing, evacuation and dehydration, charging and lubrication of refrigerating systems in CIBSE commissioning code R and manufacturer's instructions

Pre-commissioning

Carry out the procedures for pre-commissioning detailed in CIBSE commissioning code R, section R5

Combined pressure and leak testing:

Carry out the procedures for combined pressure and leak testing, including refrigerant charging, detailed in CIBSE commissioning code R, section R6

Setting to work and adjusting

Carry out the procedures for setting to work and adjusting detailed in CIBSE commissioning code R7

Absorption Systems

Carry out the procedures for preliminary checks, testing and charging, and setting to work and adjusting detailed in CIBSE commissioning Code R, section R10

Apparatus and Instruments

Use Apparatus and Instruments detailed in CIBSE commissioning code R, section R8

Apply tolerances defined in section R8.6

3070 COMMISSIONING AUTOMATIC CONTROL SYSTEMS:

Carry out commissioning of Automatic Control Systems in accordance with manual prepared by the controls equipment manufacturer

Carry out the checking and setting-up procedure detailed in the CIBSE commissioning code C, section C1

Measurement:

- Carry out measurements in accordance with CIBSE commissioning code C, appendix C2.1

3090A INSTRUMENTS AND GAUGES:

Ensure instruments are correctly calibrated. Record details of instruments on record sheets
Submit evidence of correct calibration of instruments to be used in connection with commissioning and testing

3100A AIR SYSTEMS COMMISSIONING RECORDS TO BSRIA AG 3/89.3:

Keep a systematic record of commissioning results and distribute as indicated

For air systems use record sheets as described in BSRIA application guide 3/89.3
Commissioning Air Systems in Buildings

3100B WATER SYSTEMS COMMISSIONING RECORDS TO BSRIA AG 2/89.3:

Keep a systematic record of commissioning results and distribute as indicated

For water systems

Use record sheets as detailed in BSRIA application guide 2/89.3 Commissioning Water Systems in Buildings

3110 BMS COMMISSIONING - CONTROL SYSTEM SPECIFICATION DETAILS REQUIRED FOR COMMISSIONING:

Ensure that the following information is supplied to the commissioning engineer:

A network schematic providing a record of the overall control system architecture

Schematics of the systems to be controlled indicating the location of sensors and actuators

A written description of the configured control strategies

Control strategy logic diagrams in the form of logic flow charts

Set-points and other control settings such as initial default parameters for control loops relating to the control strategies

Criteria relating to control accuracy and stability

A points list including digital inputs/outputs and analogue inputs/outputs

Control panel drawings

BMS operator workstation graphics and associated point data displaying monitored conditions

Trend logging archiving requirements and alarm routing

The scope of operational and specified functionality of management software, e.g. utility monitoring and targeting software

Functional requirements of any occupant interfaces

Details of any hard-wired interfaces from, or to, other control devices

Functionality and scope of data to be transferred over any gateway for use as part of an integrated system

Functional profiles for any direct interoperability integration

Ensure that the following is included in the BMS commissioning specification:-

A clear description of the division of responsibility between the various parties

Off-site and on-site pre-commissioning procedures

On-site commissioning procedures

Requirements for assistance to air and water balancing testing (eg opening and closing control valves) and other plant tests where the controls need to be overridden

A requirement for any point-by-point verification of correct operation

Requirements for evaluation of control loop performance/loop tuning

Requirements for the BMS operator workstation for assistance in the commissioning of plant

Arrangement for the management of delays

Phased completion requirements

Requirements for demonstration/witness testing on the basis of a percentage of points or on a point-by-point basis

Ensure that the witnessing requirement includes the identification of those responsible

Requirement for software/configuration data back-up

Requirement for, and involvement in, any complete system and sub-system performance testing

Requirement for system documentation
 Requirement for operator training requirements
 Requirement for post occupancy checks

3120 BMS COMMISSIONING - PRE-COMMISSIONING:

Ensure that as much pre-commissioning work as possible is performed off-site
 Ensure that the following is adhered to:

Table 15 Pre-commissioning requirements

Pre-commissioning action	Pre-commissioning off-site
Control application software	Yes (final commissioning on-site)
User interface software	Yes (final commissioning on-site)
Control panels	Yes (final commissioning on-site)
Terminal units (fan coil units, etc)	Yes (final commissioning on-site)
Wiring	No
Communications network	No
Sensors	No
Actuators	No
Integration gateways	Partial

Ensure that a record of all settings, set-points and offsets are maintained throughout the pre-commissioning period

Ensure that all final physical adjustments to the field devices are indelibly marked

Ensure that all packaged plant interfaced with the BMS is fully tested and commissioned by the manufacturer or installer

Ensure that the BMS is pre-commissioned in accordance with the following requirements of CIBSE Code C (Commissioning of Automatic Control Systems)

Table 16 CIBSE code C automatic control systems pre-commissioning requirements

Pre-commissioning action	CIBSE Code C section reference
Control applications software	C5.2
Control panels	C5.3
Wiring	C5.4
Communications networks	C5.5
Sensors	C5.6
Actuators and valves	C5.7
Digital inputs/outputs	C5.8
Pneumatic actuation with processor control	C5.9
Field control devices	C5.10

3130A BMS COMMISSIONING - PLANT READY FOR CONTROL SYSTEM COMMISSIONING:

Confirm that the following plant commissioning has been performed before commencing the final BMS commissioning:

Water systems

The system is cleaned and flushed to remove any debris.

All regulating, isolating and control valves in place and operating correctly.

That all flow measuring devices are in place and in the correct location for accurate measurement (including pressure tappings).

The system is vented.

That the proportional balancing is completed to obtain the branch flow rates in the correct ratio to each other (or through the use of and setting of self-balancing valves).

That the pump flow rate has been adjusted to provide the specified flow rate.

Air systems

Debris has been removed from the air distribution system.

That dampers are in the correct location and fully functional.

That fire/smoke dampers open.

Test holes have been drilled and sealed with removable plugs.

That in-situ flow measuring devices have been installed.

Ductwork air leakage testing has been performed (if specified).

Completion of proportional balancing of regulating dampers so that terminals share the air flow in the correct proportions.

Regulation of the fan(s) to provide the specified flow rate.

Packaged equipment

Ensure that plant and controls have been fully commissioned and are functional, ready for integration with other plant/systems.

That control equipment inputs/outputs are in the specified format for connection to the main control system.

Confirm that the plant is commissioned in accordance with:

Air distribution systems, CIBSE Code A

Boiler plant, CIBSE Code B

Refrigeration systems, CIBSE Code R

Water distribution systems, CIBSE Code W

Commissioning water systems

Application principles, AG 89.3/2, BSRIA

Commissioning air systems

Application systems for buildings, AG 89.3/3, BSRIA

3140 BMS COMMISSIONING - CONTROL SYSTEM REQUIREMENTS FOR PLANT COMMISSIONING:

Ensure that the BMS is pre-commissioned to allow the building services plant to operate under "manual" running conditions

Ensure that the control valves can be manually set in their fully open position to allow the balancing of pipework flows

Ensure that dampers can be manually opened to allow the commissioning of air systems

3150 BMS COMMISSIONING:

Ensure that the BMS is commissioned in accordance with the following requirements of CIBSE Code C (Commissioning of automatic control systems).

Control strategy checking - C6.2

Checking procedures for basic control functions - C6.3

Lighting controls - C6.4

Operator workstations - C6.5

Occupant interfaces - C6.6

Communication networks - C6.7

Integrated systems - gateways - C6.8

Integrated systems - direct interoperability - C6.9

Integration with fire detection systems - C6.10

Security systems - C6.11

Interruption of electrical power supplies - C6.12

Valves - C7.1

Dampers - C7.2

Fans - single speed - C7.3

Fans - variable speed - C7.4

Pumps - C7.5

4010 SYSTEM PERFORMANCE TESTING:

Demonstrate the performance of installations including single, standby, multi-duty plants and systems, and of plants specified for future use

4020A ENVIRONMENTAL TESTS, ARTIFICIAL LOADS:

Carry out environmental testing to prove the performance of the systems

Apply artificial loads or provide test arrangements to simulate the full range of operating conditions and duties

4030 RECORDERS:

Provide and maintain on free loan portable seven day space temperature and relative humidity recorders, as indicated, together with adequate charts

SECTION FOUR – TENDER SUMMARY

4.1 TENDER BREAKDOWN MECHANICAL WORKS

The sub-contractor is to state below lump sum figures for each section of the works inclusive of 2½% main contractor's discount.

1. Strip out existing services	£
2. Ventilation	£
3. Heating	£
4. Water services	£
5. Sanitary ware (install only)	£
6. Soils and wastes	£
7. Air conditioning	£
8. BMS Controls	£
9. Testing and Commissioning	£
10. As Fitted documentation	£
11. Provisional sum for unknowns	£15,000.00
12. Provisional sum for LEV to Workshop	<u>£ 6,000.00</u>

TOTAL

SIGNED

COMPANY.....

ADDRESS

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TEL NO. DATE

4.2 DAYWORK RATES

The sub-contractor is to complete the following daywork rates with the submission to tender.

	<u>Basics</u>	<u>Addition</u>
A. Materials	Nett Cost	plus %
B. Labour	(i) Hourly wage rate in accordance with National Employer/Trade Union agreements including Holiday Credits, but excluding allowances.	plus %
	(ii) Allowances.	plus %
C. Sub-contractors	Nett invoice, at contract rates.	plus %

SIGNED

COMPANY.....

ADDRESS

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TEL NO. DATE

4.3 COLLUSION

The essence of selective tendering is that the Client shall receive bona fide competitive tenders from all firms tendering. In recognition of this principle, we certify that this is a bona fide tender intended to be competitive, and that we have not fixed or adjusted the amount of the tender in accordance with any agreement or arrangement with any other person. We also certify that we have not done and we undertake that we shall not do at any time before the returnable date for this tender any of the following:

- a) Communicating to a person other than the person calling for the tenders the amount or approximate amount of the proposed tender.
- b) Entering into any agreement or arrangement with any other person relating to the tender.
- c) Offering or paying or giving or agreeing to pay or give any sum of money or valuable consideration directly or indirectly to any person for doing or having done or causing or having caused to be done in relation to any other tender or proposed tender for the said work any act or thing of the sort described above.

In this certificate the word 'person' includes any persons and anybody or association, corporate or unincorporate; and 'any agreement or arrangement' includes any such transaction, formal or informal, and whether legally binding or not.

SIGNED

COMPANY.....

ADDRESS

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TEL NO.DATE

4.4 SUB-CONTRACTORS

Should the contractor propose to utilise sub-contractor trade then they should be listed below for approval by the Consulting Engineer.

Company Name & Address

Installation