CITSO – Head Quarters & Medical Centre

Defence Infrastructure Organisation (DIO)

MECHANICAL SPECIFICATION

CITSO-ACM-XX-XX-SP-ME-000001

June 2024

Building Engineering

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Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
P01	07/06/2024	Tender	G. Rossi	George Rossi	Project Director

Distribution List

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NOTES FOR TENDERERS

This document has been compiled using text from the National Engineering Specification (NES) which is copyright to Trimble. The format and content of the specification has, however being considerably re-arranged and amended from that provided by Trimble.

The technical content of this specification has been prepared using the Common Arrangement of Work Sections for Building Works and is in four sections. Where any British or other standard referred to in the specification is either out of date or superseded by another standard, the most recent version shall apply.

For reference each work section ends with clause 10000. Here is stated the latest revision of the raw NES on which the AECOM specification work section is based.

SECTION 1 – SCOPE OF WORKS
A summary description of the Works by Work Section.

SECTION 2 – WORK SECTIONS
The specification for each Work Section is generally sub-divided into two parts:

Part 1 System objectives

The system objectives are clauses giving details of the performance and/or design parameters.

Part 3 Clauses specific to the system

These clauses are specific to the Work Section concerned.
Where clauses contain "type" references, these are for cross referencing within the specification and do not necessarily relate to manufacturers types.

NB: (***Part 2*** relates to the format used in the raw NES and selection schedules for the Y clauses. ***Part 2's are not used in AECOM specifications and are replaced by schedules in section 4***)

SECTION 3 – REFERENCE (WORKMANSHIP) SPECIFICATIONS – Y clauses
These clauses specify items that are common to several systems (for example pipework, ductwork and cabling).
The individual clauses are generally arranged in the order of the Common Arrangement "Y" sections from which they originated.
Generally, these specifications represent AECOM's standards, contain all contain clauses applicable to each particular category and are not project specific.
Where choices are required, they are made in the Schedules or Scope of Works; otherwise, all of the clauses are applicable.

SECTION 4 – SCHEDULES
This section contains schedules of drawings, manufacturers, equipment duties and selections for plant, ancillaries and system components, specific to this project. Refer to plant and equipment schedule drawings.

ENQUIRIES TO MANUFACTURERS
Enquiries to manufacturers should include all relevant sections as well as any related contractual information. ie the relevant work section and Y clauses pertinent to the plant item in addition to the plant schedule.

NON-NES CLAUSES
Clauses which are structurally different from NES from which they originated, or are AECOM originated clauses, are generally identified by the clause reference being underlined and/or the last digit of the clause number being increased e.g. 300.010 becomes 300.011.

Contents

General

Project Description

The CITSO site is situated East of Nanyuki, a town in Central Kenya. It is bounded by Mount Kenya Forest to the north, east and south, with a Civilian settlement to the west. The site is approximately 15km from Nyati Barracks. The site itself sits within the Meru County boundary.

AECOM were appointed to develop and deliver the design of two facilities within the (Counter Insurgency Terrorism and Stability Operations (CITSO) masterplan in Kenya. The two buildings that have been developed to RIBA Stage 4a (Feasible Generic) are a Headquarters building and Medical Centre.

B04 – Headquarters Building.

The Headquarters is a single storey concrete frame structure with a pitched metalwork roof. The building has been designed to provide structural stability for earthquake resilience. The Headquarters is situated towards the Western end of the site, close to the overall site entrance point.

B09 – Medical Centre

The Headquarters is a single storey concrete frame structure with a pitched metalwork roof. The building has been designed to provide structural stability for earthquake resilience. The medical centre is situated further to the East of the masterplan to offer support to a wider range of facilities within the training and accommodation areas.

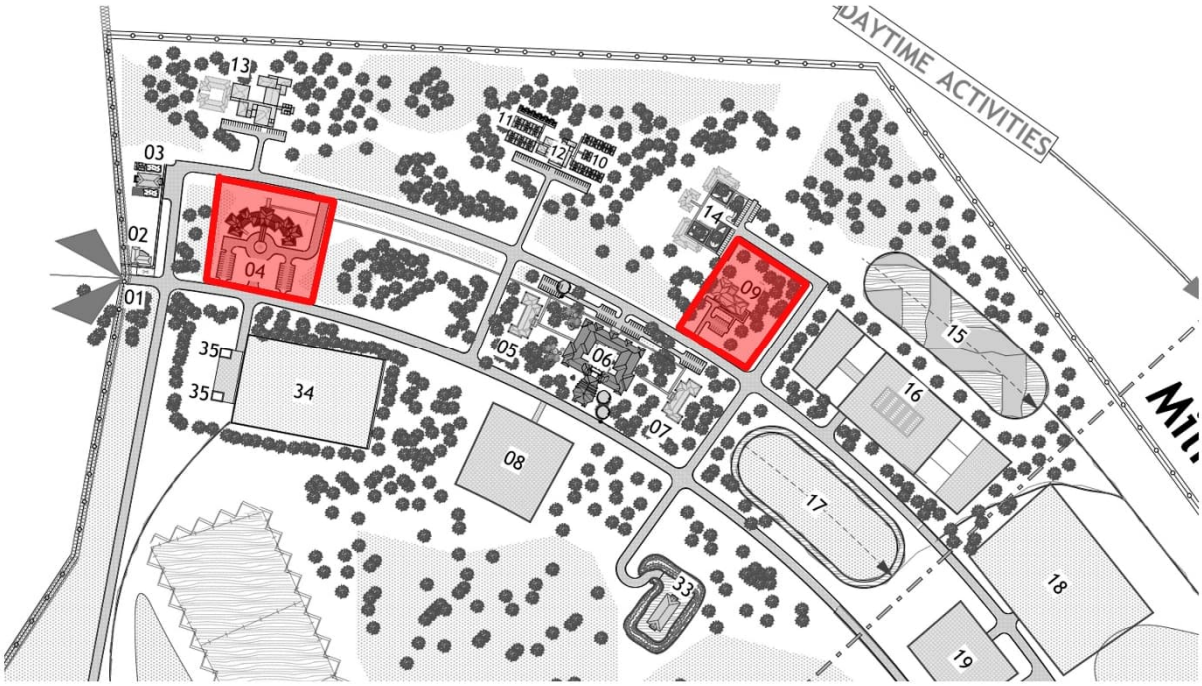

Figure GEN.1 Site Masterplan showing B04, B09 and the Northern Spine road running between the 2 No buildings.

Scope of Works

Building Services

This specification is for the supply, installation, testing and commissioning of the following mechanical fixed building services systems.

- Utilities connections - Potable Water (PW)
- Utilities connections - Fire hydrants (FH)
- Utilities connections - Foul Water (FW)
- Heating and Cooling
- Ventilation
- Domestic Hot Water Services (DHWS) with Solar Thermal Hot Water (STHW)
- Potable Water
- Reclaimed Water (RW) systems with Rainwater Harvesting (RWH)
- Above Ground Drainage (AGD)
- Controls / Building Management System (BMS)

Kenyan National and UK Standards

The mechanical services design is primarily designed to comply with the Kenyan National Building code. The design shall also comply with the more onerous requirements of both Kenyan and UK standards.

Builders Work

The demarcation of responsibilities for builders work in connection with the engineering services as defined in the Main Contract Preliminaries shall be agreed with the Main Contractor during the tender period and clearly identified in the tender submission.

The building has been designed to provide structural stability for earthquake resilience. The service routes and penetrations through internal structural walls have been designed accordingly.

Whole Building integrated system testing and Black Building testing

Integrated System Testing (IST)

After completion of all commissioning and testing of all M&E systems and plant and all interfaces between systems have been tested and proven, the contractor shall undertake IST to prove that all the stand-alone commissioned systems work together to perform the functions as defined in the specifications.

This work shall include the demonstration of functionality of all plant in conjunction with the fire alarm in fully automatic operation.

Tender Documentation

Relevant documents that should be priced include the work scope specification (this document), the workmanship clause specification and the associated drawings & schedules.

The separate workmanship clause specification documents applicable to this project must be read in conjunction with this work scope document. These workmanship documents are to be considered a reference document for the scope and must be taken in consideration within the tender price.

Working/Record Documentation
The Contractor should note the responsibility to produce certain types of information during the course of the project. This information is noted within the workmanship clause specifications that are separate to this specification but must also be read in conjunction with this specification.

For summary, this information includes the Contractor producing working drawings and record as fitted drawings. Design/installation/shop/builderswork/etc drawings should be produced at the outset of the project before materials are ordered / install commences to capture/incorporate the exact arrangements and setting out dimensioning that services are to be installed to. Note: These drawings are not to be direct copies of the tender drawings, as the tender drawings do not contain the specific installation detail which will be required by the Contractors operatives on site.

These Contractor drawings are to be developed by the Contractor throughout the project and these drawings/documents will then form the basis of record drawing presented at project handover.

Approvals
Prior to commencement of manufacture, the Contractor shall submit to the Engineer & Client working drawings for review/comment. These working drawings shall include the following:

- Dimensioned layout/installation drawings (min 1:50 scale).
- Builders-work requirements (min 1:50 scale).
- Plinth / support frame details for all items of equipment.
- Delivery and Crane allowance

Complete delivery and offloading/craneage shall be the responsibility of the Contractor.

The Contractor shall liaise with the Project Manager to ensure that all associated works are fully co-ordinated and comply with the project programme

Overview of Contractors Responsibilities			
Contractors responsibility	**Deliverables**	**Required at stage**	**Status**
Tender Stage			
Fully understand the tender documents. These consist of this specification (this may be in several volumes) and the tender drawings.		Tender Stage	Required
Visit site to make themselves fully aware of the project and site specific issues		Tender Stage	Required
Request any technical clarifications. Note that any questions raised will be confirmed in writing and issued to all tenderers.	Tender clarification documents	Tender Stage	Required
Carry out initial any design work to enable cost estimation for tendering purposes and satisfy themselves of accurate tender.		Tender Stage	Required
Submit tender. The tender should be broken down into each system as listed by the Quantity Surveyors schedules. Confirm on the tender that any technical clarifications issued have been taken into account and that the tender is fully compliant (or list any clarifications). Note that it will be assumed that the tender is fully compliant with the tender documents unless specifically stated.	Tender breakdown.	Tender Stage	Required
Pre-start on site Stage			
Visit site to carry out any surveys necessary.	Survey notes	Pre-start on site Stage	Required
Fully understand the remaining mechanical and electrical systems and any temporary works required to allow the rest of the site to continue to	RFI's as required	Pre-start on site Stage	Required

operate during the contract.			
Carry out full detailed design of all systems ensuring requirements as detailed in the tender documents are met along the requirements of the individual work sections.	Design report. Design Drawings	Pre-start on site Stage	Required
Formulate and issue technical submissions for each item of equipment and each system – agree the list of submissions with the Engineer. Note that all technical submissions should list any deviations from the specification – any items not specifically mentioned will be assumed to be fully compliant with specification. Submissions will be reviewed and given a status: (Status A – no comments, Status B – proceed but taking into account comments or Status C – rejected – re-formulate and re-submit.)	Technical submissions	Pre-start on site Stage	Required
Formulate and issue working drawings for all systems. Note that the use of AECOM drawings on site is NOT acceptable – all drawings used for installation must be working drawings produced by the contractor. To assist in this, revit and AutoCad format AECOM construction issue drawings can be provided but the Contractor must enhance these as required so they are suitable as installation drawings. Working drawings will be reviewed and given a status: (Status A – no comments, Status B – proceed but taking into account comments or Status C – rejected – re-formulate and re-submit.)	Working drawings	Pre-start on site Stage	Required
Produce builderswork drawing and schedule indicating all holes / supports requirements etc	Builderwork drawings Builderswork schedules	Pre-start on site Stage	Required
Produce a commissioning method statement	Commissioning statement	Pre-start on site Stage	Required
Produce all Health and Safety and other method statements as required by the Main Contractor, Client and Engineer.	Health and safety method statements	Pre-start on site Stage	Required
Installation Stage			
Install systems as listed in this scope of works and specification		Installation Stage	Required
Carryout snagging and rectify snags	Snagging status list	Installation Stage	Required
Offer systems for Engineer review prior to commissioning start	Completion certificate for each system	Installation Stage	Required
Commission all systems and produce report	Commissioning report	Commissionng Stage	Required
Offer results to Engineer for review and sample witnessing of the results	System acceptance sheet	Commissionng Stage	Required
Completion Stages			
Update working drawings to full record drawings taking account of any changes during the installation	Record drawings	Handover Stage	Required
Compile Operating and Maintenance manuals in the format required by the Client	O&M Manuals	Handover Stage	Required

Offer O&M manuals and Record drawings to Engineer for review and comments (status A, B or C will be given)	Electronic copy of documents for review	Handover Stage	Required
Attend site to provide familiarisation sessions with the Users for all M&E systems	Video of training sessions	Handover Stage	Required
Attend handover meetings as required – note that snag free handover is a pre-requisite for the PC certificate to be issued.		Handover Stage	
At the end of the 12 months defects period, attend site to rectify all remaining defects.	Defects completion report	End of 12 months	Required

P30 - Trenches / Pipeways / Pits for Buried Engineering Services

System Description:

For details of external services Trenches / Pipeways / Pits for Buried Engineering Services, refer to civil
engineering drawings.

R11 - Foul Drainage Above Ground

System Description:

Introduction

Multiple foul water connections will be required from both buildings to the new foul water drainage network and to the building's septic tank. Refer to civil specification.

The connections from the Soil Vent Pipes (SVP) will be gravity connections to the foul water chambers.

Both UK system type 3 (UK standard vented stacks) and UK type 2 (secondary vented stacks labelled) are proposed to suit the stack requirement; type 3 for vertical stacks and type 2 for offset stacks and stacks with horizontal drainage runs.

Where Dual flush and or low flush volume WC's (i.e. 4 litre or 4 litre dual) are to be used ensure suitable system type within BS12056 is used and system installation is suitable for reduced flush volumes – The current UK standard is system type 3 however 4 litre flush WC's are currently not permitted with this system.

Ensure the WC cisterns and pans are "matched" – refer to Architectural specification.

Floor gullies – refer to Architectural specification.

Anti-syphon and venting pipes (and anti-syphon traps) protect the traps on the appliances from loss of water/seal.

Falls on soil waste and vent pipes shall not fall below the minimum stated in BS EN 12056-2 Gravity drainage systems inside buildings – Sanitary pipework, layout and calculation system 2 or 3 and may vary depending upon system type selection (see above). Anti-syphon pipework and vent pipes must be installed in such a manner as to not create a trap.

Access must be provided at all changes of direction and above the connection point to the below ground drainage.

Generally, main soil/waste vent pipes shall rise to roof level and terminate with a vent cowl before discharge to atmosphere. Where stub stacks (SS) are indicated on the General Arrangement (GA) layout drawings and schematics, use air admittance valves only in accordance with their Agreement Certificate.

Where plastic pipework passes through fire compartment floors and walls, intumescent fire sleeves to BS 476 'Fire tests on building materials and structures' shall be fitted.

Thermal expansion must be allowed for on PVC and polypropylene soil waste and vent pipework.

S10 - Cold Water

System Description

Introduction - Potable Water

A separate metered potable water connection from the local potable water Domestic Main (DM) ring main will be required for both buildings.

The Building Connection (BC) will be located at the site boundary with a stop valve and water meter, for connection to the site DM network by the KDF.

The contractor shall allow for connection from the site demarcation points (valve pits), building entry ducts into plantrooms and building isolation valve, drain valve and primary meter.

It is proposed to provide Potable Water (PW) for domestic use to all draw-offs except for WC cisterns which will be fed from the reclaimed water system.

It is proposed to provide for a pressure break tank/water storage tank and a package booster set to provide resilience of supply - 24hour usage will require a split tank (for servicing/maintenance) with an actual storage volume of:

- HQ building - 9m^3
- MedDent building - 3m^3.

Introduction – Reclaimed Water

A Rainwater Harvesting (RWH) system is proposed for filling WC' cisterns, irrigation and wash down facilities. At this stage it is assumed that the site is subject to the lower annual rainfall per year of the Meru and Laikipia climatological regions to estimate the yield for a drought period of 18 days (as per Eurocode).

A separate RWH controller with integral break tank with infill supplies from both the RW and PW systems will supply water to the WC cisterns to maintain supplies during draught/low rain fall/peak demand conditions.

The RWH tanks form part of the civil engineering package of works. The MEP contractor shall however, supply, install, test and commission the RWH lift pump and supply pipework to the plantroom and to the RWH controller.

HQ building

Using a roof with a usable collection area of 947m^2, and an annual rainfall of 70cm, can yield an estimated 530,320 m^3 of rainfall per annum and will require a 26,000-litre storage tank.

MedDent building

Using a roof with a usable collection area of 613m^2, and an annual rainfall of 70cm, can yield an estimated 343,280 m^3 of rainfall per annum and will require a 13,000-litre storage tank.

Scope of Works

Scope

This work section incorporates S13 “Pressurised Water” Use this work section to describe the complete cold- water system including incoming mains cold water and distribution, cold water down service and boosted cold water systems.

Ensure all Plant, equipment and materials for use within domestic water systems are WRAS approved.

Avoidance of Legionnaires' Disease.
Design and install all domestic water services with the guidance contained in CIBSE TM13 and the Health and Safety Commission Approved Code of Practice L8 and associated guidance in HSG 274 Part 2

Design Parameters and British Standards
All cold water services systems should be installed in accordance with BS EN 806-2, BS EN 806-3 and supplementary guidance in BS 8558, CIBSE Guide G: Public Health & Plumbing Engineering, CIBSE TM13, HSE Approved Code of Practice L8 and associated guidance HSG274 Part 2 (The control of legionella bacteria in hot and cold water systems).

BS 8558 “Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages” is now the lead document in the area of domestic water supply. It should be read in conjunction with the BS EN 806 series and provides complementary guidance to BS EN 806. Note BS6700 has been withdrawn but is cited within the extant guidance.
BS 8558:2015 incorporates changes made in response to comments from BEAMA and has also been developed to work in conjunction with BS 8554:2015. Recommendations for flushing and disinfection have been revised to link more closely with the revised HSE ACOP L8 and HSG274 Part 2. It provides improved coverage of the control of Legionella, with references to PD 855468:2015. BS 8558:2015 also provides improved coverage of the control of Legionella, with references to the HSE’s ACoP L8 and HSG274 Part 2.

The new edition of BS 8558 also includes as an informative annex the pipe sizing calculations that originally appeared BS 6700.

The content of BS 8558 includes:
- Guidance on BS EN 806-2
- Guidance on BS EN 806-4
- Guidance on BS EN 806-5
- Annex A (normative) Examples of pumped systems
- Annex B (informative) Guidance on the calculation of hot water storage capacity
- Annex C Pipe sizing calculation.

The 5 parts of BS EN 806 are detailed below:
- BS EN 806-1:2000 - Specifications for installations inside buildings conveying water for human consumption. General
- BS EN 806-2:2005 - Specifications for installations inside buildings conveying water for human consumption. Design
- BS EN 806-3:2006 - Specifications for installations inside buildings conveying water for human consumption. Pipe sizing. Simplified method
- BS EN 806-4:2010 - Specifications for installations inside buildings conveying water for human consumption. Installation
- BS EN 806-5:2012 -Specification for installations inside buildings conveying water for human consumption. Operation and maintenance
- Consumption of water in non-domestic buildings should be calculated using BS 8542.

The fluid category to The Water Supply Regulations shall be selected and the appropriate back flow / back siphonage device selected from the guidance in the WRAS guide (ie non-mechanical, ie airgap or mechanical ie RPZ valve or check valves etc)

The user shall also check any special requirements that the water supply company, or the Local Authority may have. In some areas, for instance, the water supply companies insist on very particular protection measures before cold water storage tanks can be dispensed with.

Cistern(s)
Guidance G16.8 and Recommendation R16.8 of the Water Regulations Guide, Second Edition, discusses the provision of warning and overflow pipes to cisterns.

In summary, G16.8 states that cold water storage cisterns should have a warning pipe, installed so as to discharge water as soon as the water level reaches the overflow level of the cistern. It goes on to say that if another, no less effective device, is used instead, then an overflow pipe should also be installed.

Recommendation R16.8 suggests that a single warning/overflow pipe should be sufficient for a cistern of 1000 litres or less actual capacity. Cisterns with an actual capacity of over 1000 litres should have separate warning and overflow pipes fitted.

The recommendation defines 'actual capacity' as being the amount of water contained up to the point of overflow. The design GA layouts have been based on an actual capacity of 75% of the notional volume.

The BCWS tanks are to have a central splitter to provide two number 50% actual capacity compartments for servicing and maintenance.

Water Monitoring
A water meter shall be provided on the mains water supply to each building.
Water-consuming plant or building areas, consuming 10% or more of the building’s total water demand, will be either fitted with sub meters.

Each meter (main and sub) shall have an appropriate output to enable connection to the Building Energy Management Systems (BEMS).

S11 - Hot Water

System Description

Hot water for domestic use is to be provided by separate systems to each building.

It is proposed to provide DHWS for sinks, wash basins and showers. Hot water generation shall be provided by Solar Thermal Hot Water Systems (STHW) system. The STHW system will be backed up with DOL electrical immersion heaters., refer to section T15.

Design Parameters and British Standards

All water services systems should be installed in accordance with BS EN 806-2, BS EN 806-3 and supplementary guidance in BS 8558, CIBSE Guide G: Public Health & Plumbing Engineering, CIBSE TM13, HSE Approved Code of Practice L8 and associated guidance HSG274 Part 2 (The control of legionella bacteria in hot and cold water systems).

BS 8558 “Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages” is now the lead document in the area of domestic water supply. It should read in conjunction with the BS EN 806 series and provides complementary guidance to BS EN 806.

BS 8558:2015 incorporates changes made in response to comments from BEAMA and has also been developed to work in conjunction with BS 8554:2015. Recommendations for flushing and disinfection have been revised to link more closely with the revised HSE ACOP L8 and HSG274 Part 2. It provides improved coverage of the control of Legionella, with references to PD 855468:2015. BS 8558:2015 also provides improved coverage of the control of Legionella, with references to the HSE’s ACoP L8 and HSG274 Part 2. The new edition of BS 8558 also includes as an informative annex the pipe sizing calculations that originally appeared BS 6700.

The content of BS 8558 includes:

- Guidance on BS EN 806-2
- Guidance on BS EN 806-4
- Guidance on BS EN 806-5
- Annex A (normative) Examples of pumped systems
- Annex B (informative) Guidance on the calculation of hot water storage capacity
- Annex C Pipe sizing calculations

The 5 parts of BS EN 806 are detailed below:

- BS EN 806-1:2000 - Specifications for installations inside buildings conveying water for human consumption. General
- BS EN 806-2:2005 - Specifications for installations inside buildings conveying water for human consumption. Design
- BS EN 806-3:2006 - Specifications for installations inside buildings conveying water for human consumption. Pipe sizing. Simplified method
- BS EN 806-4:2010 - Specifications for installations inside buildings conveying water for human consumption. Installation
- BS EN 806-5:2012 -Specification for installations inside buildings conveying water for human consumption. Operation and maintenance

Avoidance of Legionnaires' Disease.

Install all domestic water services with the guidance contained in CIBSE TM13 and the Health and Safety Commission Approved Code of Practice L8 and associated guidance in HSG 274 Part 2.

S50M - Dental Vacuum and Compressed Air

System Description

The Med Dent Triage room will be 'fitted out for but not with' a dental chair and it's associated services.

The following service points are to be provided:

- PW - valved and capped connection for future dental chair
- 13A fused connection unit for single chair dental vacuum unit within designated low level cupboard
- 13A fused connection unit for single chair dental amalgam unit within designated low level cupboard.

S65 - Fire Hydrants

System Description

Introduction

Fixed firefighting systems will not be provided as part of the works. The existing CITSO site does not have any firefighting personnel.

There is no fixed firefighting hydrant system on site and the nearest fire station (Laikipia County Fire Station) is in Nanyuki, a distance of approximately 13km by road.

To provide a dedicated water supply for firefighting on site, to meet the requirements of 'ADB - Provision of private hydrants - Alternative supply of water', a static Emergency Water Supply [tank] (EWS) with a minimum capacity of 45000 litres is to be provided adjacent to each building.

The EWS is to be part of a three section cast concrete tank with a RWH tank and RWH dry well for the lift pump. and is to be filled via the RHW tank overflow,

The EWS is to have a single fixed fire hydrant to enable the firefighting appliance to connect directly to the EWS without having to access the tank. Refer to civils specification.

Scope

For pipework associated with underground hydrant pipework refer to section P30.

Provide a single fixed fire hydrant to enable the firefighting appliance to connect directly to the EWS

- Hydrants – Kenyan standard below ground fire hydrant
- Covers and frames to hydrant pits
- Hydrant indicator
- Trust blocks (Refer to civils specification)
- Testing and commissioning

T15 – Solar Water Heating

System Description

The solar hot water system shall include the calorifier, buffer tank (where necessary) solar panels, pumps, all interconnecting pipe work. The entire system shall be designed and supplied by a specialist and installed by an approved contractor who has been approved and vetted by the supplier and consultant engineer. The specification, as detailed below, is based on 'Termidrain' automatic drain-back systems [prevents damage to collection system due to overheating] manufactured by Moosa-daly. Alternative manufacturers/specialists will be considered, subject to being equal and approved.

The domestic hot water distribution and return pipework to and from sanitary and tea point appliances shall be installed by the Mechanical Contractor.

Refer to sizes on the drawings solar thermal cylinder volumes and for solar hot water collectors / generation system. This lists the key components and may not state all necessary ancillaries etc. which shall be included within the supplied system to ensure an efficient solar hot water generation system is formed to operate at an optimum efficiency, making the best use of the available Solar energy wherever possible.

The systems are to use the same manufacturer's matched system components and are to comprise of a single coil pre-insulated solar thermal storage vessel for connection to matched solar thermal collection panels, forced pumped controller, controls and safety devices. The solar thermal generation will be supplemented by electric immersion heaters for night-time and poor weather periods.

For cylinder capacity and solar thermal collector area, refer to schedules on the drawings.

Reference Documents

BS 5918:2015 Solar heating systems for domestic hot water. Code of practice for design and installation
This standard is especially intended to help fill the gap for fitted systems that have not been tested to BS EN 12976 or BS EN 12977. The Standard gives recommendations and guidance for the installation of common indirect solar domestic hot water (SDHW) systems for all types of building in the UK. It includes recommendations and guidance for design, handling, installation, commissioning, handover, maintenance, decommissioning and fault-finding.

The standard covers systems:
a) in which solar radiation is converted to heat that is primarily intended for domestic hot water preparation;
b) whose solar collectors conform to BS EN 12975-1 and BS EN ISO 9806;
C) which contain collectors that provide up to 20 kW instantaneous peak power output measured leaving the collector, when tested in accordance with BS EN ISO 9806 at 800 W/m2 perpendicular to the collector aperture plane;

NOTE Depending on the characteristics of the system, this typically equates to a gross collector area of up to approximately 30 m2.

BS EN 12975-1 Thermal solar systems and components. Solar collectors. General requirements.
BS EN ISO 9806 Solar energy. Solar thermal collectors. Test methods.
BS EN 12976-1 Thermal solar systems and components. Factory made systems. General requirements.
BS EN 12976-2 Thermal solar systems and components. Factory made systems. Test methods.
BS EN 12977-1 Thermal solar systems and components. Custom built systems. General requirements for solar water heaters and combisystems
BS EN 12977-2 Thermal solar systems and components. Custom built systems. Test methods for solar water heaters and combisystems.
BS EN 12977-3 Thermal solar systems and components. Custom built systems. Performance test methods for solar water heater stores

BS EN 12977-4 Thermal solar systems and components. Custom built systems. Performance test methods for solar combistores
BS EN 12977-5 Thermal solar systems and components. Custom built systems. Performance test methods for control equipment.

T70 - Local Cooling / Heat Pump units

System Description

Introduction

HQ Building

Heating and Cooling will be provided to the Commanders Office, Deputy Commanders Office and Boardrooms using individual Direct Expansion (DX) systems, and the Conference Room using DX systems (multiple indoor units served by a single/multiple common outdoor unit). These spaces will have individual user room temperature control.

The server room will be provided with DX cooling systems complete with internal units. These spaces will have individual user room temperature control.

Medical Centre

Heating and cooling will be provided to will be provided to the Examination Rooms, Triage Room, Observation Rooms, Drug Store and Pharmacy via DX units.

The Server Room will be provided with DX cooling systems complete with internal units. These spaces will have individual user room temperature control.

Scope

The systems are sized to provide comfort cooling in the occupied spaces to absorb the heat gains from solar radiation, fabric, equipment, lighting, infiltration, heat gains from the occupants and the fresh air load based on occupancy.

The indoor units are wall mounted units to suit the room use and configuration.

Direct Expansion (DX) Cooling System

Single DX split systems will consist of a common single outdoor condenser unit serving a single indoor unit.

Where Multiple DX split systems are used in a common space, these will consist of a single outdoor condenser unit serving each indoor unit with a single room controller.

The refrigerant pipework from remote compressor is to be used this should be selected, sized and installed by the equipment supplier i.e. the total refrigerant system must be provided by a single specialist.

Local Control Requirements
Each separate space is to have wired user controller.

Space Conditions:
Winter 21^{o}C db air temperature, humidity ‘uncontrolled’
Summer 27^{o}C db air temperature, humidity ‘uncontrolled’

U10 - Ventilation Supply/Extract

System Description

Introduction

The fresh air systems are designed to meet Building Regulations Part F 2010 providing a minimum outside fresh air supply of 10 litres per person per second. Non-occupied areas are to have the lower value of either a minimum of 6l/s per appliance or 6 air changes per hour.

The strategy for each building is as follows:

HQ Building

It is proposed to provide natural ventilation in perimeter offices and occupied spaces to meet Kenyan National Building Codes. Where this cannot be achieved, mechanical ventilation systems will be provided.

Internal occupied rooms will be mechanically ventilated based on design occupancy levels with Mechanical Ventilation Heat Recovery (MVHR) units to provide balanced Clean Supply and Extract (CSE) tempered fresh air. The ducted ventilation systems will have rectangular and circular ductwork, supply diffusers and extract grilles, system and atmospheric side acoustic attenuators, central and room user controls.

The Boardrooms will be served by MVHR units. The MVHR units will be located within the ceiling void. The intake air and exhaust for the MHVR units will be via weather louvres in the external wall; the weather louvres have been located between the structural ceiling slab and the structural ring lintel with due allowance for the suspended ceiling supports and ceiling levels. The supply and extract ductwork will be routed in the ceiling void with fire dampers fitted on the fire compartmentation boundaries (walls and structural ceiling slab).

The Conference Room will be served via a separate Air Handling Unit (AHU) located in the platform adjacent. The AHU with have thermal wheel type heat recovery (to minimise the plant spatial requirements). The intake air and exhaust for the MVHR unit will be via weather louvres in the external wall; the weather louvres have been located between the structural ceiling slab and the structural ring lintel. The supply and extract ductwork will be routed in the roof void with fire dampers fitted on the fire compartmentation boundaries (walls and structural ceiling slab).

The toilets will be mechanically ventilated utilising local extract fans.

Medical Centre

It is proposed to provide natural ventilation in perimeter offices and occupied spaces to meet Kenyan National Building Code. Where this cannot be achieved, mechanical ventilation systems will be provided.

Internal occupied rooms will be mechanically ventilated based on design occupancy levels with MVHR units to provide balanced CSE tempered fresh air. The ducted ventilation systems will have rectangular and circular ductwork, supply diffusers and extract grilles, system and atmospheric side acoustic attenuators, central and room user controls.

The triage room, lab, reception, pharmacy, and drug store will be served by a central MVHR unit. The MVHR unit will be located within the plant room. The intake air and exhaust for the MHVR unit will be via weather louvres in the external wall; the weather louvres have been located between the structural ceiling slab and the structural ring lintel. The supply and extract ductwork will be routed in

the ceiling void with fire dampers fitted on the fire compartmentation boundaries (walls and structural ceiling slab).

The kitchen, toilets, showers, and clinical waste store will be mechanically ventilated utilising local extract fans.

Scope

Refer to Clause100.010:
'Comply, as detailed in the scope of works and / or A13sch, with the requirements of BS EN 16798-3 and additional guidance in PD CEN/TR 16798-4 to achieve the specified category of supply air (SUP) with defined category of outdoor air (ODA)'

FILTRATION EFFICIENCY DEPENDING ON OUTDOOR AND SUPPLY AIR CATEGORY
BS EN 16798-3 / PD CEM/TR 16798-4
Classification of outdoor air - categories
ODA 1 - Outdoor air which may be only temporarily dusty (e.g. pollen)
ODA 2 - Outdoor air with high concentrations of particulate matter and/or gaseous pollutants
ODA 3 - Outdoor air with very high concentrations of gaseous pollutants and/or particulate

Classification of supply air - Categories
SUP 1 - Supply air with very low concentration of particulate matter and/or gases
SUP 2 - Supply air with low concentrations of particulate matter and/or gases
SUP 3 - Supply air with medium concentrations of particulate matter and/or gases matter
SUP 4 - Supply air with high concentrations of particulate matter and/or gases matter
SUP 5 - Supply air with very high concentrations of particulate matter and/or gases matter

Table B.3 Recommended minimum filter classes per filter section (definition of filter classes according to EN 779)

EN 16798-3:2017 (E)

Table B.3 — Recommended minimum filter classes per filter section (definition of filter classes according to EN 779)

Outdoor air quality					
	SUP 1	SUP 2	SUP 3	SUP 4	SUP 5
ODA 1	M5+F7	F7	F7	F7	-
ODA 2	F7 + F7	M5 + F7	F7	F7	M5
ODA 3	F7 + F9	F7 + F7	M6 + F7	F7	F7

To maintain a good sanitary level in the ventilation system the minimum combined filtration efficiency of mechanical supply air needs to meet filtration class F7 in accordance with EN 779.

To maintain a good sanitary level in the ventilation systems the minimum combined filtration efficiency of
mechanical supply air needs to meet filtration class F7 in accordance with EN 779.

CONTROL REQUIREMENTS

Refer to Work Section W60.

Air Leakage testing of Ductwork
All low-pressure ductwork to be treated as follows:

Strength & leakage testing of circular ductwork to BS EN 12237 and rectangular ductwork to BS EN 1507 is acceptable as an alternative to DW143

EC / DC Motors
EC / DC motors are to be used in the mechanical ventilation systems

Indoor Air Quality
The buildings have been designed to provide fresh air into the building in accordance with the criteria of the relevant standards for ventilation:

- Building Regulations Approved Document F
- BS EN 13779:2007 and BS EN 15423 for fire precautions for air distribution systems in buildings.

For air-conditioned and mixed-mode buildings:

Air intakes and exhausts in relation to each other and external sources of pollution shall be in accordance with BS
EN 13779:2007
Where present, the HVAC systems incorporate suitable filtration to minimize external air pollution, as defined in
BS EN 13779:2007

W60 - Central Control / Building Energy Management System

System Description

The HQ building and the Medical Centre operate independently. There is no site Building Energy Management System (BMES) system. The BEMS Mechanical Control Panel(s) (MCP) are to provide full control and monitoring and alarm functions and HMI displays mounted on the front of the panel doors. The BEMS/MCP are to include the provision of network communications suitable for future connection to a future 'Client Server/front end PC as detailed in Section W60 workmanship clauses.

Scope of works

This specification covers the following control systems.

System	Control	Description	BEMS Alarms	Power
DX comfort cooling	Local hard wired controllers	Provide local user room control of temperature set point via a hard-wired controller in each separate space with DX comfort cooling. Temperature sensing via the terminal unit.	Common fault for each separate unit.	To outdoor unit from MCP. Indoor unit power/control umbilical from outdoor unit to indoor unit (control cable circuit to be continuous – not interrupted by local isolators)
Central AHU	BEMS User on/off	Time schedules Temperature	Common fault Filter clean/dirty	From MCP
Local MVHR	Local hard wired controllers	Time schedules Fan speed	Common fault	From MCP
Local extract fans	BEMS	Time schedules	N/A	From MCP
STHW	Hard wired system control unit	Temperature of collectors Temperature of cylinder	Common fault High temperature	From MCP
BCWS	Hard wired system control unit	Constant pressure, variable flow	Common fault	From MCP
BCWS	Tank level	Infill control	High (H) Low (L)	From MCP
RHW	Hard wired system control unit	Dedicated RWH controller with external tank lift pump	Common fault	From MCP
Fire Alarm	BEMS	Interlocks	N/A	N/A
Water Metering	BEMS	Metering and data logging	Out of range values	N/A
Electrical Metering	BEMS	Metering and data logging	Out of range values	N/A

System Maintenance
Provide maintenance support for 1 year in accordance with BSRIA BG 4/03 - BMS Maintenance Guide.

Dead bands
Configure the thermal conditioning control system to allow for a temperature dead band of at least 7ºC in order to reduce the risk of heating and cooling simultaneously and to reduce energy consumption.

** End of Scope Sections **

100.010 PERFORMANCE OBJECTIVES

To provide excavation, backfill, beds and surrounds for buried pipelines, cables and ducts other than ordinary drainage pipelines.
To lay ducts for telecommunications and data cables.
To provide stop valve surface boxes, access chambers, draw pits and inspection chambers and the like.
To permanently reinstate roads and paths affected by excavations.
All work on underground services shall be in accordance with the guidance in HSG47 – Avoiding danger from underground services

Positioning and planning of utilities shall be in accordance with the latest revision of the following NJUG Guides and specific Part 3 clauses in this specification:

Volume 1: NJUG Guidelines on Positioning and Colour Coding of Underground Utilities
Volume 2: NJUG Guidelines On The Positioning Of Underground Utilities Apparatus for New Development Sites
Volume 3: NJUG Guidelines on the Management of Third Party Cable Ducting
Volume 4: NJUG Guidelines for The Planning, Installation and Maintenance of Utility Apparatus in Proximity to Trees
Volume 5: NJUG on-site environmental good practice guidelines

PART 3 SPECIFICATION CLAUSES SPECIFIC TO P30

300.000 GENERAL

300.010 SUPPLY AUTHORITY REQUIREMENTS:
Ensure all system components are approved by the appropriate Supply Authority and installed in accordance with their requirements. Arrange for them to inspect and approve installations as they proceed.

300.021 ROUTES OF SERVICES BELOW GROUND:
Based on the approximate locations indicated on the drawings, agree precise locations with the CA. Set out trenches clearly and accurately. Locate with temporary marker posts. Excavate trenches taking due care of existing services in the vicinity, carefully setting aside any materials required for backfilling or reinstatement. Ensure that the minimum cover for services is achieved at all times taking into account the location and levels of existing services.

Trench
Allow common trench for all underground services where appropriate.

300.030 SUPPLY OF PIPE DUCTS:
Supply PVC pipe and cable ducts as indicated on the drawings.

300.061 SERVICE CABLE AND PIPE DUCTS: [NES 300.060]
Lay ducts in the formation shown, on newly prepared bedding. Joint ducts in accordance with the manufacturer's instructions.
Ensure that ducts slope no more than 1:60 vertically and 1:30 horizontally.
Ensure that pre-formed duct bends used at ends of duct routes meet the requirements of the cable manufacturer for bending radii.
Prove alignment of completed duct run by drawing through a mandrel 7mm diameter less than nominal duct bore for minimum length 250mm. Clean completed duct run by drawing through a circular wire brush 12mm diameter more than nominal duct bore.
Install a draw wire of corrosion resistant material and minimum breaking strength 550N in each empty duct.
Plug and seal all ducts with proprietary duct plugs, on completion.

310.000 PRODUCTS/MATERIALS

310.020 BEDDING & BACKFILL:
Application - External Services

Lay external services on 100 mm imported soft sand. Cover and provide 100mm minimum cover of imported soft sand prior to back filling.

Bed and surround ducts generally with 100 mm single sized 10 mm aggregate to BS EN 12620. Lay and compact uniformly in 100 mm layers.
Bed and surround ducts in 150 mm Concrete to BS 8500-1 / BS EN 206.
20mm aggregate sulphate resisting where necessary, where under roads.
Backfill generally with selected fill, free from vegetable matter, rubbish, frozen soil and excluding lumps and stones retained on a 40mm sieve. Thoroughly compact by hand in layers not exceeding 100 mm.
Backfill under roads with granular sub-base material type 1 to Manual of Contract Documents for Highways Works Vol 1 Clause 803.
Cover newly laid cables with 100mm of bedding material.
Lay cables on newly prepared bedding. Ensure multiple layers of cable are separated vertically by a 50mm layer of hard rammed bedding material. Cover newly laid cables with 100mm of bedding material.
Following back filling permanently re-instate all retained road and footpath surfaces, landscaping, channels, kerbs and edgings etc. and to their previous condition. ie to all areas that are outside of the site boundary.

310.030 ACCESS/INSPECTION CHAMBERS/DRAW PITS:
Provide as indicated on the drawings.
Construct as indicated on the drawings.

320.000 WORKMANSHIP

320.001 STRUCTURES:
Ensure pipes in and out of structures are as short as possible. Surround by concrete at least 150mm thick. Set pipes sufficiently steep to prevent the possibility of differential settlement causing a backfall.

320.002 BACKFILLING OVER CONCRETE:
Do not start backfilling within 24 hours of placing concrete. Do not use heavy compactors and prevent imposition of traffic loads within 72 hours of placing concrete.

320.003 TEMPORARY BRIDGES:
Provide temporary bridges over trenches as necessary to prevent construction traffic damaging pipes after backfilling.

320.011 SERVICE TRENCHES: (NES 300.050)
Provide service trenches to allow the services to be installed, including any separation, in accordance with:

- BS 7671 IET Wiring Regulations
- BS EN 50174-3 - Information technology. Cabling installation. Installation planning and practices outside buildings.
- The appropriate regulations associated with water supply to the building(s).
- The Gas (Installation and Use) Regulations 1998 and IGEM Transmission and Distribution (TD) Series Standards.
- OFTEC Technical Book 3, BS 5410-1 for installations serving domestic buildings up to 70kW output capacity.

Width to be as small as practicable with sides vertical.
Remove mud, rock projections, boulders and hard spots from trench bottom and trim level.
Carry out walk over survey of trench route, trial hole any area considered to be potentially difficult. Submit report of survey and trial holes and re-plan service routes after survey and trial holes if required.
Establish locations of any other underground service adjacent to service route.
Carry out any indicated work to adjacent services if necessary.
Inform Architect / CA in advance to give them reasonable opportunity to inspect trench for each section of the work.
Excavate trench carefully setting aside any materials required for backfilling or reinstatement and remove excess excavated material from site.
Clear trench bottom of loose stones and place bedding to full width of trench.
Grade trench bottom to a maximum slope of 1:12.

Layout and identify services as NJUG guidelines for positioning and colour coding of underground utilities apparatus.
Carry out all work in adopted streets to comply with the New Roads and Streets Works Act 1991 and associated codes of practice.

320.020 LAYING PIPES/PIPEDUCTS/UTILITY SERVICES:
Use slings that do not damage either pipe or coating. Thoroughly inspect pipes prior to slinging.
Do not lower pipes until the trench bottom has been approved to receive the pipes. Ensure pipes are in correct alignment and orientation, concentric with the pipes already laid.
Make joints in accordance with manufacturer's instructions using the proprietary materials indicated.
Use a purpose made adapter for joints between pipes of different materials. If none is available, abut the pipes, tape and seal the gap, surround by 1/2 sections or less for 1m either side of the joint and surround in C20 concrete 150mm thick for 2m either side of the joint.
Install PVC-U pipes and fittings in accordance with BS EN 1401

Lay straight to line, true to gradient or level on an even, continuous bed of the specified bedding material, laid over full width of trench. Provide draw ropes where required.
Protect from damage and ingress of debris, temporarily seal all exposed ends during construction.
Inform Architect / CA and service utilities or subcontractors to give them reasonable opportunity to inspect installation prior to backfilling.
Lay and compact further bedding material to a level not less than 100 mm above crown of pipe.

320.021 BEDDING, PROTECTION AND BACKFILL PIPEWORK:
Make cavities in the bedding to facilitate sling removal. Elsewhere smooth the trench bottom. Prepare one full pipe length in advance of pipelaying.
Locate interfaces between backfilled materials to the weaker material side of theoretical.
Concrete is the strongest and selected fill the weakest. Lay all fill less than 300mm above the top of the pipe barrel in 150mm layers and hand compact. Above this level layers may be 225mm. Over 1m above top of pipe mechanical compaction may be used

320.025 CABLE TRENCHES:
A 100mm depth tolerance shall be included when digging trenches, therefore all services shall be at the depth indicated below plus 100mm. This will allow for the possibility of the ground level being reduced by 100mm.
Haunch cables or ducts in bedding material to a minimum depth of 75mm above highest cable or duct.
Install PVC marker tapes to all trenches as detailed below.
Minimum cover in cable trenches

HV cables 800mm (900mm depth).
LV cables 500mm (600mm depth).
Communications cables 500mm.
All cables 900mm minimum cover under roadways.

Mark each change of direction of cables with pre-cast concrete 300x300x150 thick impressed with LV or HV CABLE, laid level with finished ground level.

Installation to be in accordance with latest revision of NJUG Guides:
Utilities Guidelines on Positioning and Colour Coding of Apparatus (Vol 1)
Guidelines for the Planning, Installation and Maintenance of Utility Services in Proximity to Trees. (Vol 4)

320.025a PIPEWORK TRENCHES ETC:
Minimum cover in pipework trenches

Water 750mm minimum (900 -1200mm maximum where practical)
Gas 600mm (footway), 750mm (verge), 900mm (carriageway).
Fuel oil 900mm

To latest revision of NJUG Guides:
Utilities Guidelines on Positioning and Colour Coding of Apparatus
Guidelines for the Planning, Installation and Maintenance of Utility Services in Proximity to Trees

Install PVC marker tapes to all trenches as detailed below.
All services to be 900mm under roadways.

320.030 BACKFILLING GENERALLY:
Laid and well compacted in layers not exceeding 300 mm thick. Do not use heavy compactors before there is 600 mm depth of backfill.

320.040 BACKFILLING UNDER ROADS:
Laid and compacted in 150 mm layers.

320.051 TEMPORARY BRIDGES:
Provide temporary bridges over trenches as necessary to prevent construction traffic damaging services after backfilling.

320.061 IDENTIFICATION TAPES:
During backfilling lay continuous colour coded, heavy gauge polythene identification tapes, below surface along the route of each service. Warning tapes to be to BS EN 12613

WIDTH	up to 600mm	600-1000mm	1000-1400mm	1400-1800mm
DEPTH up to 500mm	1 tape at 200mm below ground level in the centre of the trench	2 tapes at 200mm below ground level horizontally spaced 400mm apart	3 tapes at 200mm below ground level each tape horizontally spaced 400mm apart	4 tapes at 200mm below ground level each tape horizontally spaced 400mm apart
DEPTH 500-800mm	1 tape at 200mm and 1 tape at 500mm below ground level in the centre of the trench	2 tapes at 200mm and 2 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart	3 tapes at 200mm and 3 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart	4 tapes at 200mm and 4 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart

320.070 ACCESS/INSPECTION CHAMBERS CONSTRUCTION:
As indicated on the drawings.
Step irons : Bed in joints to all chambers over 900 mm deep at 300 mm vertical centres staggered 300 mm horizontally, with the lowest step iron 300 mm above the base and the top step iron 450 mm below the top of the cover.
Precast slabs : Bed solid in 1:3 cement: sand mortar.

320.080 ACCESS COVER & FRAME INSTALLATION:
Bed frame solidly in 1:3 cement: sand mortar over its whole area, centrally over opening, level with surrounding finishes and square with joints in surrounding finishes or with building. Where frame is in soil or grassed areas, haunch back edge of bedding so that it is not visible.

320.090 TEMPORARY DRAWPIT CONSTRUCTION:
Fill pit with clean dry sand on completion of services installation.

10000 Based on NES P30 / S16 TEXT Dec 19

R11 – Foul Drainage Above Ground

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide a piped gravity system to collect foul water from normal toilets, sinks and kitchen appliances and connect to the first underground drain connection.

100.020 DESIGN PARAMETERS
In accordance with BS EN 12056-2, BS EN 752, CIBSE Guide G: Public Health Engineering, current Building Regulations and requirements of the Local Authority.

100.022 BREEAM REQUIREMENTS:
On applicable projects and detailed elsewhere, comply with BREEAM requirements below to suit the type of construction and scheme.
BREEAM New Construction 2014 requirement
Comply with Issue ID Pol 03 Surface Water Run-off
Comply with Issue ID Wst 05 Adaptation to Climate Change
BREEAM New Construction 2018 requirement
Comply with Issue ID Pol 03 Flood and Surface Water Management
Comply with Issue ID Wst 05 Adaptation to Climate Change
BREEAM Refurbishment and Fit-out 2014 requirement
Comply with Issue ID Pol 03 Surface Water Run-off
Comply with Issue ID Wst 05 Adaptation to Climate Change

100.030 GENERAL REQUIREMENTS
Refer also to Scope of Works.
The system has generally been designed on the one pipe system, using foul waste and vent stacks which take the foul water discharge from the toilet areas, shower areas and cleaners sink etc.

Anti-siphonage and ventilating pipes (and or anti-siphon traps) protect the traps on the appliances from loss of water/seal.

All soil waste and ventilating pipes shall have minimum falls as defined in BS EN 12056-2, or as shown on the drawings. Anti-siphonage pipework and ventilating pipes must be installed in such a manner as not to create a trap.

Access shall be provided at all changes of direction and above the connection point to the below ground drainage as shown on the drawings.

Main soil/waste ventilation pipes shall rise to roof level and terminate with a vent cowl for discharge to atmosphere.

Where plastic pipework passes through fire compartment floors and walls intumescent fire sleeves tested to BS 476 or BS EN 1366-3 shall be fitted.

Drainage pipes that are encased in a facade or cladding system shall be constructed from non-combustible material. Unless detailed otherwise elsewhere pipework to be stainless steel to relevant parts of BS EN 1124. Pipework to be designed to accommodate thermal expansion.

Thermal expansion shall be included on PVC and polypropylene soil waste and vent pipework.
Where pipes penetrate a floor separating habitable rooms in different flats within residential buildings they shall be enclosed for their full height and full horizontal run in each flat and surrounded with sound absorbent material above and below the floor. The installation shall comply with the requirements of Approved Document E of the Building regulations. “Resistance to the passage of sound”.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO R11

300.000 PRODUCTS/MATERIALS

300.005 DRAINAGE SPECIALIST:

R11 – Foul Drainage Above Ground

On design and build projects engage a drainage specialist to develop the design, install, commission and set to work a gravity drainage system inside the building in accordance with BS EN 12056 as appropriate.

300.011 SOIL WASTE AND VENT PIPEWORK

Refer to Schedule of pipelines Y10 for project particular requirements

Materials standards

PVC-U – BS EN 1329-1 / BS 4514

300.014 THERMAL EXPANSION ON ALL PVC/POLYPROPYLENE PIPEWORK

Provide expansion joints, thermal movement limiters, anchor points and support/brackets to allow for the correct thermal movement as recommended in the manufacturers installation guide. Alternative forms of thermal expansion arrangements will not be allowed without the prior approval of the CA.

300.015 METAL BANDED FLEXIBLE COUPLINGS ADAPTORS AND BUSHES:

N/A

300.016 FIRE SLEEVES

Fire sleeves shall be installed on all PVC/Polypropylene pipework 50mm diameter and above, passing through fire break walls, floors and ceilings and subject to approval by the Local Building Control Authority. To be tested to BS EN 1366-3.

300.017 HORIZONTAL BRANCH CONNECTIONS

All 75mm and 100mm branch connections shall connect to the main horizontal runs via a 135 degree branch and a 135 degree bend.

Where possible all smaller branch connections shall connect to the 75mm and 100mm horizontal runs at an angle of 45 degree above the centre line via a 135 degree bend.

300.018 VENT PIPE TERMINALS

All soil waste and vent stacks and waste and vent stacks shall, unless otherwise stated, shall rise through the roof finish with a weathering slate weathering collar and terminate 450 mm above the roof finish (flat or pitched) with a vent cowl.

300.020 FLOOR GULLIES

Standard

Trapped with water seal of at least 50mm - BS EN 1253-1

Without trap - BS EN 1253-2

Gully with light liquid closure to avoid uncontrolled discharge of light liquids such as petrol, diesel and fuel oil into drainage systems in case of emergency to BS EN 1253-5

Material.

Access covers to BS EN 1253-4

Class of gully / cover – as scheduled

300.035 GREASE TRAPS AND GRAVITY GREASE SEPARATORS:

N/A

300.040 FALLS ON SOIL/WASTE PIPEWORK AND VENT PIPEWORK

Unless otherwise stated

All 75mm and 100mm dia. soil and waste pipework shall be installed to a fall of 1:60 all smaller dia. waste pipework shall be installed to a fall of 1:50.

All vent and anti-siphon vent pipework shall be installed to a fall of between 1:80 and 1:100.

300.045 WASTE PIPEWORK DIAMETERS (UNLESS OTHERWISE STATED)

Washhand basin	32mm
Sinks (general)	40mm
Cleaners Sinks	40mm
Shower Tray	40mm
Urinal Bowls	32mm/40mm (as sanitary fitting schedule)
W C Pans	100mm
Bidets	32mm

Specialist equipment waste pipework as per manufacturers' requirements.

300.050 SOIL AND WASTE STACKS TAKING THE DISCHARGE FROM PLANTROOM FLOOR GULLIES

Unless otherwise stated soil waste and vent stacks which take the discharge from plantroom floor gullies shall be installed in cast iron and not PVC.

300.130 PLASTICS WC PAN CONNECTOR

Combined solvent weld/pan seal socket connector for horizontal outlet WC pans to BS EN 33 or BS EN 997

For horizontal outlet and shrouded pans

BS 5627 for pans to BS EN33 'S' (turned 'P' traps, or 'P' traps new installations, or 'P' traps replacements) or BS EN 997 for WC pans and WC suites with integral trap.

300.140 GRATINGS:

Application

Vent pipe termination guards

Material

Galvanised steel wire, plastic coated, PVC or copper.

300.150 SINGLE STACK PLUMBING:

Ensure that there is a change of gradient at stack connections. Use swept branches on small diameter pipes. Use swept inlet or 45 degree branch connections for pipe 75 mm dia. or over.

310.000 WORKMANSHIP

310.005 FOOT OF PIPE STACKS:

Fix cast iron rest bends supported on brick-work or concrete bases where indicated on drawings.

310.010 PERFORMANCE CRITERIA:

Install pipework fittings and accessories to ensure that:-

appliances drain quickly, quietly and completely at all times without nuisance or risk to health.

discharge is conveyed without crossflow, backfall, leakage or blockage.

air from drainage system does not enter building.

pressure fluctuations in pipework do not vary by more than plus or minus 38mm water gauge and traps retain a water seal of not less than 25mm.

system can be adequately tested, cleaned and maintained.

310.020 PIPE ROUTES:

Ensure pipe routes are shortest practicable, with as few bends as possible and no bends in wet portion of soil stacks, unless indicated otherwise on drawings.

310.030 COATED PIPES:

Make good damaged coatings and cut ends, or recoat, as recommended by manufacturer.

310.041 INSTALLATION GENERALLY:

Install pipes, fittings and accessories in accordance with BS 8000-0, BS 8000-13, BS EN 12056-2 and manufacturer's recommendations.

Install thermoplastic piping systems in accordance with PD CEN/TR 13801.

Obtain all components for each type of pipework from the same manufacturer, unless otherwise indicated.

Inspect components carefully before fixing and reject any which are defective.

Ensure cut ends of pipes to be clean and square with burrs removed.

Allow for thermal and building movement when jointing and fixing in accordance with tile manufacturers recommendations.

Form junctions using fittings intended for the purpose, ensuring that jointing material does not project into bore of pipes, fittings and appliances.

Avoid contact between dissimilar metals and other materials which would result in electrolytic corrosion.

Provide access covers and cleaning eyes as necessary in convenient locations, to permit adequate testing and cleaning of pipework.

Prevent entry of foreign matter into any part of system by sealing openings during construction. Fit all access covers and cleaning eyes as work proceeds.

310.050 CONNECTIONS BETWEEN PIPES OF DIFFERENT MATERIALS:

PLASTIC

PLASTICS

N/A

CAST IRON

N/A

COPPER

N/A

GALVANIZED STEEL

N/A

310.070 WASTES:

Bed in waterproof jointing compound and fix with resilient washer between appliance and backnut.

310.080 WASTE CONNECTORS:

Join to traps as manufacturer's recommendations.

310.091 WC PANS:

Connect to soil pipe spigots with plastic connectors in accordance with connector manufacturer's recommendations.

310.100 TRAP TEST REQUIREMENTS:
Ensure there is a retention of 25mm water seal in every trap, and that no air is blown through the trap seal when performance is tested.

310.110 ACCESS POINTS:
Provide rodding and access points at all changes of direction to enable whole system to be maintained.
Provide square door type access points as indicated on drawings at foot of all soil waste and ventilation pipes and at low level above each floor level. Where practicable, locate access points and horizontal anti-siphon pipes above fitment flood level.
In general make WC connections to drain points and soil pipes via flexible connectors.

10000 Based on NES R11TEXT – Dec 19

S10 – Cold Water

Incorporating S13 (pressurised water) and S16 (Borehole water / well water)

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES

To provide a piped water supply system to bring water from the supply authority's main and distribute it to a variety of user points.
To provide water storage and a piped water supply system distributing cold water services to a variety of user points using gravity and/or pressure boosters as indicated on the drawings and schedules.
Where a borehole is required, engage a borehole and well specialist to develop, design, supply, install (including all civil works), commission and set to work the borehole/well pumping system.

100.020 DESIGN PARAMETERS

For installations inside buildings In accordance with relevant parts of BS EN 806 and supplementary guidance in BS 8558, CIBSE Public Health Engineering Guide G, CIBSE TM13, HSE Approved Code of Practice & Guidance L8 and associated guidance in HSG 274 Part 2 (The Control of Legionella Bacteria in Water Systems).
For water supply systems outside buildings comply with the requirements of BS EN 805.
Comply with the requirements of:

England and Wales - The Water Supply (Water Fittings) Regulations 1999, as amended, the Water Act 2014 and The Construction Products Regulations 2013.
Scotland - The Water Supply (Water Fittings) Byelaws 2014.
Northern Ireland - The Water Supply (Water Fittings) Regulations (Northern Ireland) 2009.
Comply with appropriate WRAS guidance.

Comply with WRAS guidance on prevention of contamination and waste of drinking water supplies.
On healthcare projects comply with the requirements of the relevant parts of HTM 04-01.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO S10

300.000 PRODUCTS/MATERIALS

Refer to scope of works and schedules in addition to the clauses below.
The contractor shall provide comprehensive data sheets for all water services components to validate specification compliance and for approval, this shall include a valid WRAS (or equal and approved) approval number with expiry date.
In addition to the particular valve type standard, valves to be used in, or connected to, water supply pipe systems, above or below ground carrying water intended for human consumption to comply with the relevant parts of BS EN 1074 and BS 5163 as appropriate to the application.

300.001 PRESSURE EQUIPMENT DIRECTIVE/PRESSURE EQUIPMENT REGULATIONS:

All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 2014/68/EU, implemented in the UK through the Pressure Equipment (Amendment) Regulations 2015 and The Pressure Equipment (Safety) Regulations 2016, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.

Only relevant equipment and assemblies certified as compliant will be permitted under this specification, and any substitution put forward must also be compliant with the Directive.

300.005z APPROVALS:

Ensure all water fittings and materials are listed in the Water Fittings and Materials Directory published by WRAS.

Water regulations – Notification of works and Inspections:
The contractor shall notify the local water authority of any notifiable water services installation in accordance with regulation 5 and 6 and arrange for a water authority inspection and approval of installation before handover of the building in accordance with Water Supply (water fittings) Regulations 1999 as amended.

300.007 BREEAM REQUIREMENTS (REFURBISHMENT):

N/A

300.008 BREEAM REQUIREMENTS (NEW BUILD):

All water systems must be designed in compliance with HSE L8 Legionnaires' disease. “The control of legionella bacteria in water systems. ACOP and guidance (fourth edition, 2013)”. Details may comply with CIBSE TM13 Minimising the Risk of Legionnaires' Disease, in demonstrating that the design meets the criteria of HSE ACOP.

Humidification systems to be failsafe.

On applicable projects and detailed elsewhere, comply with BREEAM requirements below to suit the type of construction and scheme.

BREEAM New Construction 2014 requirements

Comply with Issue ID Wat 01 Water Consumption.

BREEAM New Construction 2018 requirements

Comply with Issue ID Wat 01 Water Consumption.

300.011 WATER METERS

Install a water meter to the incoming mains supply and / or sub meters within the building as scheduled or described in the scope of works. Install in line strainer upstream of each water meter. Locate the meters to allow for easy access for meter reading by the building’s occupants.

Meters and the installation to comply with The Measuring Instruments Regulations 2016

Standards – comply with relevant parts of BS EN ISO 4064

Provide full flow accumulative type water meter with dial indicator to record quantity of water passed. Enclose mechanism of each meter within a cast iron body with a helical vane mounted centrally in the body of the meter. Supply an interchangeable pattern mechanism. Incorporate, as an integral part of each meter, a water guide at inlet to direct water evenly on to helical vane. Provide each meter with zeroing device.

Mechanical/electrical meters or meters with a digital indicating device and other types of electronic or magnetic meter, to be complete with all necessary components and facilities. These shall include transducer, sensor, adjustment and correction facilities, indicating device to display volume continuously or periodically on demand and facilities for interface with a BMS.

Ancillary (additional functionality) devices for Smart Metering to comply with BS EN 14154-4 - refer to schedules for details.

Provide isolating valves on either side of each meter assembly (bypasses on potable water systems should be avoided due to the risk of water stagnation/legionella).

Provide flanged connections to BS EN 1092-1, BS EN 1092-2 or BS EN 1092-4 on each meter. Where meters are of smaller bore than connecting pipework, install flanged reducers.

Provide facility for remote monitoring of peak flow and total water consumption by BMS.

Where a BREEAM credit is required for water meters comply with relevant BREEAM issue ID and ensure all meters shall have pulsed output and are connected to the BMS and ensure meters are installed on large water consuming plant equal to or greater than 10% of the total water demand of the building. Comply with BREEAM 2014 Issue ID Wat 02 or BREEAM New Construction 2018 Wat 02 Water Monitoring.

300.016 LEAK DETECTION SYSTEM:

Supply and install a leak detection system and an automatic shut-off system to ensure no further water is delivered where indicated on the drawings and described in the scope of works. Link the system to an integral alarm system or BMS if installed.

Where a BREEAM credit is required for a leak detection system comply with relevant BREEAM issue ID.

BREEAM New Construction 2014 requirement

Comply with Issue ID Wat 02 Water Monitoring

Comply with Issue ID Wat 03 Water Leak Detection

BREEAM New construction 2018 requirement

Comply with Issue ID Wat 02 Water Monitoring

Comply with Issue ID Wat 03 Water Leak Detection

It shall have the following features.

Audible alarm

Activate when flow of water sensed by the water meter data logger is above a pre-set maximum for a pre-set period of time.

Is able to identify different flow rates.

Is programmable

Can be programmed to avoid false alarms caused by normal operation of lager water consuming plant

Where the building is being assessed to the WELL Building Standard v1 comply with feature 12 Moisture Management as appropriate.

300.041 SAFETY SHOWERS
Safety Drench - Plumbed-in type, to BS EN 15154-1.
Eye wash. - Plumbed-in type, to BS EN 15154-2.

300.061 PACKAGED WATER BOOSTER SETS
The units are to be WRC approved.
Supply a fully automatic, works tested packaged unit on common base plate or skid complete with flexible connections and AV mountings.
To be complete with hydraulic accumulator / expansion vessel to BS EN 13831, filled with nitrogen and sized to limit the pump starts to a maximum of 10 starts per hour. Unless scheduled otherwise accumulator to be "flowjet" type flow-through and include shut-off and discharge valve.
Diaphragm material to be WRAS approved in accordance with relevant parts of BS 6920.

Booster set to be complete with multiple pumps, pre-wired control panel and interconnecting pipework.
Refer to schedule for pump / pressure control method, alarms and BMS interfaces.
Provide control module to provide surge protection on start-up or when power is restored by allowing only one pump to be enabled and pulsed for a pre-set time until a pre-set pressure is reached.

Duty, controls and general components to be as scheduled.

300.061a BOOSTER SET CONTROL PANEL
Enclosure Fabricate from mild steel sheet 1.6mm thickness minimum,
Finish Manufacturer's standard
Components and further details as scheduled
Refer to clause W60 320.101 for control panel design and construction.

300.062 BASE EXCHANGE WATER SOFTENER:
Refer to section S20, clause 310.111 and schedules

300.065 PHYSICAL WATER CONDITIONERS:
Refer to schedule S10sch2

300.066 ULTRAVIOLET DISINFECTION:
N/A

300.067 CHLORINE DIOXIDE GENERATION PLANT AND DOSING:
N/A

300.068 SAFETY OF EQUIPMENT: [S16 300.060]
Ensure all data communications equipment is designed, installed and commissioned in accordance with,
BS EN 60950-1
BS EN 62368-1

300.070 ELECTROMAGNETIC COMPATIBILITY: [S16 300.070]
Ensure all equipment complies with the Electromagnetic Compatibility Regulations 2016.
Ensure all equipment carries the CE Mark, and is suitable for the electromagnetic environment in which it is to be used, for the service to which it is to be put.
Ensure that all control and monitoring system cabling is selected and installed to comply with the EMC requirements of BS 7671 (IET Wiring Regulations) and BS EN 50174-series.

310.000 WORKMANSHIP
Comply with the requirements of BS EN 8000-0 and BS 8000-15 where applicable on domestic scale projects.

310.005 INSTALLATION GENERALLY

Install, test and commission systems to comply with BS EN 806-4 and complimentary guidance in BS 8558, Water Supply (Water Fittings) Regulations 1999 or bylaws and equipment manufacturer's recommendations.

England and Wales - The Water Supply (Water Fittings) Regulations 1999, as amended by The Water Supply (Water Fittings)(Amendment) Regulations 1999, The Water Act 2003 (Consequential and Supplementary Provisions) Regulations 2005 and The Construction Products Regulations 2013.
Scotland - The Water Supply (Water Fittings) Byelaws 2014.
Northern Ireland - The Water Supply (Water Fittings) Regulations (Northern Ireland) 2009.

Flushing and disinfection of services suppling water for domestic use to be carried out in accordance with BS EN 806-4 and following the guidance in BS 8558 and PD 855468. Refer to the pipework cleaning and chemical treatment section of this specification for details.
Construct the system to ensure it is safe and without risks to health and where applicable incorporate in the final design/installation recommendations given in HSG274 Part 2.
Locate sampling points following the guidance and recommendations in the Code of Practice for the sampling and monitoring of hot and cold water services BS 8554 and document these in a sampling plan prepared in accordance with BS EN ISO 5667-1.
Undertake sampling following construction completion in accordance with the guidance and recommendations in BS 8554.
Undertake microbiological tests on samples and provide the results as part of the handover documentation to demonstrate that the systems are clear of organisms of concern. Preserve and handle samples in accordance with BS EN ISO 5667-3.
Install thermoplastics pipework in accordance with BS 5955-8.

310.010 CONNECTIONS TO TAPS AND APPLIANCES AND EQUIPMENT

Make final connections to taps and appliances including the incorporation of a flow regulator within the fitting isolation valve where the static pressure exceeds 1 bar.
For electrical appliances connected to water mains, comply with the manufacturer's recommendations and requirements of BS EN 61770 as below:

To prevent the backsiphonage of non-potable water into the water mains
Flexible hose assemblies intended to be used as integral parts of appliances, to be in accordance with the standard

Flexible hose assemblies designed for connecting appliances to drinking water installations to be in accordance with BS EN 13618.

310.015 FLEXIBLE HOSES IN POTABLE WATER SUPPLIES IN HEALTH CARE BUILDINGS

The use of flexible connections to taps, appliances and pipeline ancillaries such as mixers shall be restricted to situations where there is no suitable alternative, i.e. make “hard” connections to taps and appliances wherever possible using bendable metallic pipes instead of flexible hoses.

Where flexible hoses must be used (eg washing machines or hi-low baths) comply with the following:

Under no circumstances are flexible hoses lined with EPDM shall be used.
Use only WRAS approved flexible hoses, lined with a suitable alternative to EPDM such as either PE, PEX, LLDPE or PVCC and installed without kinking or distorting them during installation.
All hoses must be clearly marked and identified by the hose manufacturer, as stated under the WRAS approval listing.

310.020 INSTALLATION OF WATER COOLERS

Install water coolers in accordance with manufacturer’s instructions.

310.022 INSTALLATION OF WATER METERS:

Install water meters in accordance with manufacturer's instructions and BS EN ISO 4064-5
Comply with the requirements of BS EN 14154-4 for additional functionality devices associated with Smart Metering.

310.030 INSTALLATION OF PRESSURE BOOSTER SETS

Install pressure booster sets in accordance with manufacturer’s recommendations
On healthcare projects comply with HTM 04-01 Part A.

310.031 INSTALLATION OF UV DISINFECTION SYSTEMS

Install and commission UV disinfection equipment in accordance with manufacturer's recommendations
N/A

310.032 INSTALLATION OF CHLORINE DIOXIDE DOSING PLANT
N/A

310.033 INSTALLATION OF WATER CONDITIONERS
N/A

310.051 ISOLATION
Install isolation valves at the following locations as a minimum standard.

At all terminal units

At all sanitary fittings.

At all main branch connections and at high level in feeds which drop to low level to water outlets in benches etc.

Where piped services feed a zone or floor from risers

All quick fill points and bib taps shall comply with the Water Supply (Water Fittings) Regulations1999 including where connected into a sub circuit of an existing building.

310.060 GROUND INVESTIGATIONS: [S16 300.025]
N/A

310.070 EXCAVATION
Excavate in a clean and organised manner. Schedule with other site activities to provide controlled access and minimal tracking of soil over the site.

Set out and use sight boards to ensure uniform falls.
Separate top soil and set aside for later use.
Evacuate trench width to a minimum of 300mm above the top of the pipe barrel within indicated limits.
Keep available materials for adequate shoring when excavation depth over 1.2m is intended.
Where rock is encountered in trench bottoms designed as Class D bedding further excavate to the depth necessary to receive Class F.
Backfill over-excavation, whether intentional at soft spots or accidental with rubble.
Spoil, which is either in excess of or does not fulfil the requirements for selected fill.
Place in spoil heaps, or take off site as directed.

310.052 [S16] PIPE LAYING:
Use slings that do not damage either pipe or coating. Thoroughly inspect pipes prior to slinging.
Do not lower pipes until the trench bottom has been approved to receive the pipes. Ensure pipes are in correct alignment and orientation, concentric with the pipes already laid.
Make joints in accordance with manufacturer's instructions using the proprietary materials indicated.
Use a purpose made adapter for joints between pipes of different materials. If none is available, abut the pipes, tape and seal the gap, surround by 1/2 sections or less for 1m either side of the joint and surround in C20 concrete 150mm thick for 2m either side of the joint.

310.060 [S16] STRUCTURES:
Ensure pipes in and out of structures are as short as possible. Surround by concrete at least 150mm thick. Set pipes sufficiently steep to prevent the possibility of differential settlement causing a backfall.

310.070A [S16] BEDDING, PROTECTION AND BACKFILL:
Make cavities in the bedding to facilitate sling removal. Elsewhere smooth the trench bottom. Prepare one full pipe length in advance of pipelaying.
Locate interfaces between backfilled materials to the weaker material side of theoretical.
Concrete is the strongest and selected fill the weakest. Lay all fill less than 300mm above the top of the pipe barrel in 150mm layers and hand compact. Above this level layers may be 225mm. Over 1m above top of pipe mechanical compaction may be used.

310.080 [S16] BACKFILLING OVER CONCRETE:
Do not start backfilling within 24 hours of placing concrete. Do not use heavy compactors and prevent imposition of traffic loads within 72 hours of placing concrete.

310.090 [S16] TEMPORARY BRIDGES:
Provide temporary bridges over trenches as necessary to prevent construction traffic damaging pipes after backfilling.

310.100 [S16] WARNING MARKER TAPES:
Lay during backfilling in a continuous line over pipelines, 300 to 400mm below the level of the finished surface.
Lay an additional marker 600mm above the top of the pipeline for pipes at a greater depth than 800mm.

320.050 LIFTING KEYS:
Provide lifting keys for each type of access cover and hand over to the Employer at Practical Completion.

320.060 [S16] WATER TESTING OF MANHOLES/INSPECTION CHAMBERS:
Before backfilling test each manhole or chamber in accordance with BS EN 752 and BS EN 1610 for Exfiltration and Infiltration.

340.000 WORKMANSHIP [S16]

340.010 [S16] PIPELINE ROUTES:
Ensure pipeline routes are as short as possible consistent with,
natural topography and subsoil conditions.
as far as possible increasing slopes downstream.
avoidance of tree root growth areas.

340.020 [S16] MATERIALS IN THE WORKS:
Inspect all buried materials prior to installation. Make good damaged coatings and cut ends.
Reject where damage is more than superficial.

340.030 [S16] QUALITY CONTROL:
Check that all materials comply with the indicated standard before acceptance to store. Transport, handle and store in accordance with manufacturer's recommendations, to avoid damage or contamination.
Obtain all components for each type of pipework from the same manufacturer.
Ensure cut ends of pipes are clean, square and free of burrs.
Prepare trenches to receive pipes and allow for jointing, testing and removal of slings.
Install all components in accordance with the manufacturer's recommendations.
Joint according to manufacturer's recommendations and allow for movement, taking particular care next to buildings and manholes.
Prevent entry of foreign matter and clean prior to testing or putting to use.
Backfill and compact in layers to ensure adequate consolidation.

340.060 [S16] INSULATION:
Where control components are incorporated in insulated pipelines, ductlines or equipment, provide details for approval of method proposed to insulate component.

340.070 [S16] SUPPORTS:
Arrange supports for control components to ensure no strain is imposed on components.

340.080 [S16] ACCESS:
Arrange control components and enclosures to ensure adequate access for operation and maintenance

10000 Based on NES S10Text Dec 19, S13 Mar 16 and S16 Dec 18

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES

To provide a piped supply system generated, storing and distributing hot water to sanitary fittings, sinks and other appliances. DHW systems shall be designed to deliver water to take-off points at a temperature of not less than 50ºC and not exceeding 60ºC.

BREEAM
On applicable projects and detailed elsewhere, comply with BREEAM requirements below to suit the type of construction and scheme.
BREEAM New Construction 2018 requirement
- Comply with Issue ID Ene 01 Reduction of Energy Use and Carbon Emissions
- Comply with Issue ID Ene 04 Low Carbon Design

BREEAM Refurbishment and Fit-out 2014 requirement
- Comply with Issue ID Ene 01 Reduction of Energy Use and Carbon Emissions
- Comply with Issue ID Ene 04 Low Carbon Design

100.020 DESIGN PARAMETERS

In accordance with relevant parts of BS EN 806 and supplementary guidance in BS 8558, CIBSE Public Health Guide G, CIBSE TM 13, HSE Approved Code of Practice & Guidance L8 and associated guidance in HSG 274 Part 2 (The Control of Legionella Bacteria in Water Systems).
Comply with the requirements of:

England and Wales - The Water Supply (Water Fittings) Regulations 1999, as amended by The Water Supply (Water Fittings)(Amendment) Regulations 1999, The Water Act 2003 (Consequential and Supplementary Provisions) Regulations 2005 and The Construction Products Regulations 2013.
Scotland - The Water Supply (Water Fittings) Byelaws 2014.
Northern Ireland - The Water Supply (Water Fittings) Regulations (Northern Ireland) 2009.

If required in the scope of works, undertake calculation of design heat load and storage volume for domestic hot water in accordance with BS EN 12831-3.

Comply with appropriate WRAS guidance.

In addition to controls requirements detailed elsewhere in the specification, provide the minimum controls package for compliance with Part L as defined in the Non Domestic Building Services compliance guide

On healthcare projects comply with the requirements of the relevant parts of HTM 04-01 and supplement D08 for TMV's.

Unvented hot water storage systems to be complete with "unvented kits" and pressure regulating valve to comply with Building Regulations safety requirements within Approved Document G3. Indirectly heated storage water heaters shall comply with BS EN 12897.

See Schedule of Common Design Criteria.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO S11

300.000 PRODUCTS/MATERIALS

See scope of Works and Schedules in addition to clauses below.
The contractor shall provide comprehensive data sheets for all water services components to validate specification compliance and for approval, this shall include a valid WRAS (or equal and approved) approval number with expiry date.
Comply with EU Regulation 814/2013 with regard to eco-design requirements for water heaters with rated heat output of up to 400kW and hot water storage tanks with a storage volume of up to 2000 litres regarding limiting standing loss and product information.

Manufacturers to undertake energy assessment of domestic / sanitary hot water storage tanks of up to 2000 litres in accordance with BS EN 15332.
Manufacturers to comply with the test methods in BS EN 50440 to measure the performance of electric storage water heaters.
Gas fired domestic appliances producing hot water to be in accordance with relevant parts of BS EN 13203.

300.001 PRESSURE EQUIPMENT DIRECTIVE/PRESSURE EQUIPMENT REGULATIONS:
All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 2014/68/EU, implemented in the UK through the Pressure Equipment (Amendment) Regulations 2015 and The Pressure Equipment (Safety) Regulations 2016, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.

Only relevant equipment and assemblies certified as compliant will be permitted under this specification, and any substitution put forward must also be compliant with the Directive.

300.005 APPROVALS:
Ensure all water fittings and materials are listed in the Water Fittings and Materials Directory published by WRAS.

300.008 WATER METERS:
Type / duty / details / BMS interface - as scheduled or detailed in scope of works
Install sub water meters to the water supplies as detailed. Locate the meters to allow for easy access for meter reading by the building's occupants.
Standards - BS EN ISO 4064-1, BS EN ISO 4064-2, BS EN ISO 4064-3, BS EN ISO 4064-4
Meters for potable water to be WRc approved.
For mechanical analogue cumulative meters provide a dial indicator to record quantity of water passed.
Enclose mechanism of each meter within a cast iron body. Incorporate, as an integral part of each meter, a water guide at inlet to direct water evenly on to the meter. Provide each meter with a zeroing device.
Mechanical/electrical meters or meters with a digital indicating device and other types of electronic or magnetic meter, to be complete with all necessary components and facilities. These shall include transducer, sensor, adjustment and correction facilities, indicating device to display volume continuously or periodically on demand and facilities for interface with a BMS.
Ancillary (additional functionality) devices complying with BS EN 14154-4 for Smart Metering.
Provide isolating valves on either side of each meter, and full-bore valved bypass installed around meter assembly.
Provide facility for remote monitoring through pulsed output.
Electrical supply - 24V DC.

300.020 INSTANTANEOUS WATER HEATER(S):
N/A

300.030 STORAGE WATER HEATER(S):
N/A

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300.032 HEAT PUMP WATER HEATER(S):
N/A

300.050 THERMOSTATIC MIXING VALVES:
Valves to be WRAS approved. All non-metallic parts in contact with water shall meet WRAS requirements or comply with relevant parts of BS 6920.
Valves to be independently tested and approved to BuildCert scheme TMV3 unless detailed otherwise elsewhere in this specification.
Location - Where indicated or scheduled.
Standard/type
BS EN 1111 for high operating pressure (static up to 10bar and dynamic 1-5bar)
Type 1 - single control for regulating flow and temperature
Type 2 - dual control- separate control devices for regulating flow and temperature.
Type 3 - single sequential control with a single control operating through a predetermined

sequence of flow and temperature.
BS EN 1287 for low operating pressure (Static up to 10bar and dynamic 0.2-1bar)
Type 1 - single control for regulating flow and temperature
Type 2 - dual control- separate control devices for regulating flow and temperature.
Type 3 - single sequential control with a single control operating through a predetermined sequence of flow and temperature.
For care establishments comply with BS 7942 (which complements BS EN 1111 and BS EN 1287 where a particular risk of scalding exists to the user) and HTM 04-01: Supplement – Performance specification D08 thermostatic mixing valves (healthcare premises).
Type A, both flow control and user adjustment of mixed water temperature.
Type B, flow control and pre-set mixed water temperature.
Type C, without flow control and with pre-set temperature.
Category 1 - with electronic temperature adjustment, mixed water temperature changed progressively.
Category 2 - with electronic temperature adjustment, mixed water temperature changed by predetermined step each time it is activated.

Material
Body - DZR brass.
Finish
Chrome plated

300.055 THERMAL CIRCULATION VALVES:

Type - Thermostatically controlled self-balancing.
Application -Thermostatic regulation of return water temperature in HWS systems with circulation pump and thermal disinfection at temperatures above 70°C.
Location - Where indicated or scheduled.
Standard - WRAS approved
Materials
Body – bronze to BS EN 1982
Bonnet and associated parts – DZR brass
Stem – stainless steel
O-Ring seals – EPDM rubber, WRAS approved
Body seat – PTFE
Duty - as indicated on drawings or scheduled.
Accuracy - +/- 2°C at set temperature
Required features
Temperature gauge access point.
Adjustable temperature setting facility.
Additional thermostatic insert to increase flow when temperature of 70°C to effect disinfection.
Integral isolation valve.

300.060 MECHANICAL MIXING VALVES:

Standard
BS EN 1286
Single control for adjusting flow rate and temperature.

300.080 EXPANSION VESSELS:

Standards
Supply WRAS approved expansion vessels for unvented hot water supply systems in accordance with the following standards.
BS 6144 for unvented hot water supply systems
BS EN 13831
Relevant parts of BS 6920.

310.000 WORKMANSHIP

Comply with the requirements of BS 8000-15 where applicable on domestic scale projects.

310.005 INSTALLATION AND COMMISSIONING GENERALLY

Install, test and commission systems to comply with equipment manufacturer's recommendations, BS EN 806-4 , complimentary guidance in BS 8558 and relevant Water Supply (Water Fittings) Regulations or Byelaws and equipment manufacturer's recommendations

England and Wales - The Water Supply (Water Fittings) Regulations 1999 as amended, the Water Act 2014 and The Construction Products Regulations 2013.
Scotland - The Water Supply (Water Fittings) Byelaws 2014.
Northern Ireland - The Water Supply (Water Fittings) Regulations 2009.

Flushing and disinfection of services supplying water for domestic use to be carried out in accordance with BS EN 806-4 and following the guidance in BS 8558 and PD 855468. Refer to the pipework cleaning and chemical treatment section of this specification for details.
Construct the system to ensure it is safe and without risks to health and where applicable incorporate in the final design/installation recommendations given in HSG274 Part 2.
Locate sampling points following the guidance and recommendations in the Code of Practice for the sampling and monitoring of hot and cold water services BS 8554 and document these in a sampling plan prepared in accordance with BS EN ISO 5667-1.
Undertake sampling following construction completion in accordance with the guidance and recommendations in BS 8554.
Undertake microbiological tests on samples and provide the results as part of the handover documentation to demonstrate that the systems are clear of organisms of concern. Preserve and handle samples in accordance with BS EN ISO 5667-3
Install thermoplastics pipework in accordance with BS 5955-8.
Undertake thermal balancing of HWS and CWS systems in accordance with Commissioning Specialist Association Technical Memorandum TM19.

310.015 FLEXIBLE HOSES IN POTABLE WATER SUPPLIES IN HEALTH CARE BUILDINGS
The use of flexible connections to taps, appliances and pipeline ancillaries such as mixers shall be restricted to situations where there is no suitable alternative, i.e. make “hard” connections to taps and appliances wherever possible using bendable metallic pipes instead of flexible hoses.

Where flexible hoses must be used (eg washing machines or hi-low baths) comply with the following:
Under no circumstances are flexible hoses lined with EPDM shall be used.
Use only WRAS approved flexible hoses, lined with a suitable alternative to EPDM such as PE, PEX, LLDPE or PVCC and installed without kinking or distorting them during installation.
All hoses must be clearly marked and identified by the hose manufacturer, as stated under the WRAS approval listing.

310.020 CONNECTIONS TO TAPS AND APPLIANCES
Make final connections to taps and appliances including the incorporation of a flow regulator within the fitting isolation valve where the static pressure exceeds 1 bar.
For electrical appliances connected to water mains, comply with the manufacturer's recommendations and requirements of BS EN 61770 as below:
To prevent the backsiphonage of non-potable water into the water mains
Flexible hose assemblies intended to be used as integral parts of appliances, to be in accordance with the standard
Flexible hose assemblies designed for connecting appliances to drinking water installations to be in accordance with BS EN 13618.

310.030 WATER HEATER INSTALLATIONS
Comply with manufacturer’s instructions and recommendations for the installation of heater.
Locate heater with adequate surrounding space for service and maintenance.

310.040 INSTALLATION AND COMMISSIONING OF THERMOSTATIC MIXING VALVES:
Install and commission thermostatic mixing valves and mechanical mixing valves in accordance with manufacturer's recommendations.
On healthcare projects comply with HTM 04-01Part A and HTM 04-01 supplement: performance specification D 08 - thermostatic mixing valves (healthcare premises).
For TMV2 and TMV3 approved valves comply with the scheme's installation and maintenance documentation requirements.
For TMV3 approved valves comply with the scheme onsite testing requirements.

310.050 INSTALLATION OF WATER METERS:
Install water meters in accordance with manufacturer's instructions and BS EN ISO 4064-5
Comply with the requirements of BS EN 14154-4 for additional functionality devices associated with Smart Metering.

310.051 ISOLATION

Install isolation valves at the following locations as a minimum standard.

At all terminal units

At all sanitary fittings.

At all main branch connections and at high level in feeds which drop to low level to water outlets in benches etc.

Where piped services feed a zone or floor from risers

10000 Based on NES S11Text. Dec 19

S65 – Fire Hydrants

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES

To provide a water pipework distribution system, in the ground outside the building, with standpipes fitted with fire hose connections and arranged to provide an adequate source of water for fire fighting

Where the town's main supply does not provide sufficient pressure and capacity to provide the necessary supply provide two interconnected storage tanks and pumps in accordance with the requirements of BS 9990. Refer to clauses 310.031 – 310.071 and work sections / schedules Y20 & Y21 or S65 scope of work for pump and tank details / duties.

100.020 DESIGN PARAMETERS

To the requirements of DIFS, BS 9990, BS 9999 and those of the Local Fire Officer/Local Authority.

See Schedule of Common Design Criteria and scope of works.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO S65

300.000 GENERAL

300.001 PRESSURE EQUIPMENT DIRECTIVE/PRESSURE EQUIPMENT REGULATIONS:
All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 2014/68/EU, implemented in the UK through the Pressure Equipment (Amendment) Regulations 2015 and The Pressure Equipment (Safety) Regulations 2016, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.

Only relevant equipment and assemblies certified as compliant will be permitted under this specification, and any substitution put forward must also be compliant with the Directive.

300.010 STANDARDS

Comply with BS 9990 and BS 9999

300.020 FIRE AUTHORITY REQUIREMENTS

Ensure all system components are approved by Local Authority Fire Brigade

300.030 BONDING

Incorporate provision for earth bonding in accordance with BS 7671 (IET Wiring Regulations).

300.040 INTEGRATION, CONTROL AND MONITORING:
N/A

300.050 SOFTWARE:
Where relevant on particular projects, obtain on behalf of the end users all appropriate licences, N/A

310.000 PRODUCTS/MATERIALS

310.011 HYDRANTS

Pillar hydrants

To be supplied with integral 'ducks foot' bend at the base.

Size and inlet/outlet configurations as indicated on the drawings

Standards BS 9990, BS EN 14384

310.021 UNDERGROUND HYDRANTS

Size and inlet/outlet configurations to suit application or as indicated on the drawings

Standards:

Underground hydrants in accordance with BS 750 and BS EN 14339.

Surface box frame and cover in accordance with BS 750 and BS EN 14339.

Indicate position of hydrant by use of a cast iron plate in accordance with BS 3251.

310.031 AUTOMATIC PUMPS FOR FIRE HYDRANT SYSTEM:
N/A

310.032 PUMPS FOR FIRE HYDRANT SYSTEM:
N/A

310.041 PUMP TESTING:
N/A

310.042 CONTROL PANEL
N/A

310.050 ELECTRIC SUPPLIES FOR FIRE HYDRANT PUMPS AND CONTROLS:
N/A

310.061 PUMP INITIATION LOCAL CONTROL:

N/A

310.071 REMOTE ALARM PANEL
N/A

320.000 WORKMANSHIP

320.010 HYDRANTS

Install and test fire hydrants in accordance with BS 9990

Install, test and commission all fire protection systems to requirements of local Fire Authority.

320.020 QUALITY CONTROL:
Where relevant on particular projects record all commissioning tests and site modifications to hardware or software, and revise operating and maintenance instructions accordingly.
Manage configuration of software settings, data and design, in accordance with an appropriate Configuration Management Plan (CMP), complying as necessary with BS EN ISO 9001, BS ISO 10007, BS ISO/IEC 12207 and BS ISO/IEC/IEEE 15288.
Provide configuration details along with the operation and maintenance manual on hand-over.
Manage information security of systems, software and data during design, implementation and commissioning in line with BS EN ISO/IEC 2700

10000 NES- Based on S65 TEXT Dec19

T15 – Solar Water Heating

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide a heat source by means of a solar collection system.

100.020 DESIGN PARAMETERS
See Schedule of Common Design Criteria and scope of works.
BREEAM
New Construction 2014 requirement
- Comply with Issue ID Ene 01 Reduction of Energy Use and Carbon Emissions
- Comply with Issue ID Ene 04 Low Carbon Design
- Comply with Issue ID Wst 05 Adaptation to Climate Change
- BREEAM New Construction 2018 requirement
- Comply with Issue ID Ene 01 Reduction of Energy Use and Carbon Emissions
- Comply with Issue ID Ene 04 Low Carbon Design
- Comply with Issue ID Wst 05 Adaptation to Climate Change

Refurbishment and Fit-out 2014 requirement
- Comply with Issue ID Ene 01 Reduction of Energy Use and Carbon Emissions
- Comply with Issue ID Ene 04 Low Carbon Design
- Comply with Issue ID Wst 05 Adaptation to Climate Change

PART 3 SPECIFICATION CLAUSES SPECIFIC TO T15

300.000 GENERAL

300.001 PRESSURE EQUIPMENT DIRECTIVE/PRESSURE EQUIPMENT REGULATIONS:
All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 2014/68/EU, implemented in the UK through the Pressure Equipment (Amendment) Regulations 2015 and The Pressure Equipment (Safety) Regulations 2016, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.

Only relevant equipment and assemblies certified as compliant will be permitted under this specification, and any substitution put forward must also be compliant with the Directive

300.002 BUILDING REGULATIONS PART L:
Comply with the requirements of the latest versions of the Building Regulations and CIBSE Solar heating design and installation guide for minimum requirements / standards for indirect solar water heating.

300.005 RENEWABLE HEAT INCENTIVE (RHI):
N/A

300.010 SOLAR COLLECTOR SPECIALISTS:
Engage a specialist to provide a solar collector system, including:
- Plant design, development of concept design, supply, installation, commissioning and setting to work of the complete system.

The specialist shall follow the recommendations and guidance in BS 5918 for systems that provide up to 20kW instantaneous peak power and whose solar collectors conform to BS EN 12975-1 and BS EN ISO 9806.
For single thermal collector systems up to 45kWth the specialist shall be Microgeneration Certification Scheme (MCS) certified.

300.020 APPROVAL AND SAFETY:
Obtain approval for the installation and operation of the solar collector system from appropriate Local Authorities and comply with all safety requirements and regulations including.
- Planning permission.

England and Wales - The Water Supply (Water Fittings) Regulations 1999 as amended, the Water Act 2014 and the Construction Products Regulations 2013.
Scotland - The Water Supply (Water Fittings) Byelaws 2014.
Northern Ireland - The Water Supply (Water Fittings) Regulations (Northern Ireland) 2009.
Building regulations.
Health and Safety at Work Act and relevant HSE ACOP's including L8 and associated guidance in HSG 274 Part 2 for the control of legionella bacteria in hot and cold water systems.

300.030 TESTING:

Standard

Test all solar collector panels at the manufacturer's works in accordance with BS EN ISO 9806

System test

Test factory made systems in accordance with BS EN 12976-2
Test custom built systems in accordance with BS EN 12977-2, BS EN 12799-3, BS EN 12977-4 and BS EN 12977-5 as appropriate.
Test pipework to pressure and temperature conditions of the system.
Commission domestic hot water systems which contain collectors that provide up to 20 kW instantaneous peak power and have not been tested to BS EN 12976 or BS EN 12977 in accordance with BS 5918.

310.010 SOLAR COLLECTOR SYSTEM – PRODUCTS AND MATERIALS

(based on NES 310.010, 310.020, 310.021, and 310.030)

See Scope of Works/Schedules for details and duties

Standards

Solar collectors to comply with BS EN 12975-1 for requirements on durability, reliability and safety and BS EN ISO 9806 for testing the durability, reliability, safety and performance of solar collectors.
Flat plate solar absorber to have been tested by the manufacturer as meeting the limiting change in performance for surface durability in accordance with BS EN ISO 22975-3.
Evacuated tubes to be inspected and tested by the manufacturer for material defects, durability and performance in accordance with BS EN ISO 22975-1.
Heat pipe vacuum tube collectors to be tested by the manufacturer for durability and performance in accordance with BS EN ISO 22975-2.
For custom built systems comply with relevant parts of and BS EN 12977 depending on system configuration.
For factory made systems including combined solar collector / water storage units , comply with BS EN 12976-1 for general requirements and BS EN 12976-2 for test methods.

310.040 ELECTRICAL WIRING AND SAFETY CONTROLS:

Standards

Provide the solar collector installation with electrical wiring and safety controls in accordance with:
Manufacturer's recommendations and BS EN 12976
Comply with relevant parts of BS EN 60730 and BS EN 60335 regarding electrical controls and safety.
BS 7671 (IET. Wiring Regulations).

310.045 CONTROL REQUIREMENTS:

Unless detailed otherwise in work section W60 the Solar Collector Specialist shall supply and install a Control panel to provide:

Sequence control between heating from boiler and solar panels (with solar to take lead).
Control of fluid circulating pumps.
Net energy yield (taking account of energy to run circulation pump).
High temperature alarms.
The following BMS Interfaces - Energy statements/usage, High temperature alarms, Pump run/trip, System common fault.

310.051 SELF-SUPPORTING FRAMEWORK:

Install a self-supporting framework of corrosion resistant material for the solar collector panel arrangement.

Refer to drawings for details of framework mounting

310.071 MEMBRANE EXPANSION VESSEL:

Supply WRAS approved expansion vessels for unvented hot water supply systems in accordance with BS EN 13831

Duty and details as scheduled

Accessories

Safety valve for installation in pipework

All necessary fixing straps for wall mounting or feet for floor mounting

Isolation / drain valve assembly, comprising drain valve and lock shield ball valve to BS EN 12828

310.072 INTERMEDIATE, AUXILLARY VESSEL:

Install inline auxiliary vessel before expansion vessel to limit the system fluid temperature at the inlet to the expansion vessel.

Duty and details as scheduled

Accessories

All necessary fixing straps for wall mounting or feet for floor mounting

Isolation / drain valve assembly, comprising drain valve and lock shield ball valve to BS EN 12828

310.075 HEAT TRANSFER MEDIUM:

Refer to schedules for details

Fluid to be selected by the solar panel manufacturer and be complete with all necessary corrosion protection and anti-aging additives.

320.000 WORKMANSHIP

320.010 INSTALLATION:

Install, commission and set to work the solar collector system in accordance with the manufacturer's instructions.

Design, install, commission and provide documentation for custom built thermal solar heating systems and components in accordance with BS EN 12977-1.

Install, commission and provide documentation for factory made thermal solar heating systems and components in accordance with BS EN 12976-1.

Follow the recommendations and guidance in BS 5918 for the installation, handling, commissioning, handover and maintenance of indirect solar domestic hot water (SDHW) systems for systems that provide up to 20kW instantaneous peak power and whose solar collectors conform to BS EN 12975-1 and BS EN ISO 9806.

320.020 LOCATION:

Locate the solar collector in accordance with:

BS EN 12976-1 for factory made systems

BS EN 12977-1for custom built systems

BS 5918 for up to 20kW instantaneous peak power.

Take account of:

existing buildings, trees.
thermal performance.
orientation.
shade factor.
wind exposure.
access for maintenance.
pipework connections.
inspection access.
vandalism.

320.030 QUALITY CONTROL:

Handle, store and install all equipment and components of the solar collector system in accordance with the manufacturer's recommendations and good practice so as to meet the design and performance requirements. Obtain all solar collector system components from approved sources.

Inspect all components on delivery before fixing and after installation and reject and replace any which are damaged or defective.

Allow for thermal and building movement when fixing and joining components and pipework.

320.040 PIPEWORK INSTALLATION:

Install the solar collector system pipework in accordance with the manufacturer's recommendations.

Provide a means of automatic deaeration and air release fitted in the flow pipework as close as possible to the solar collector panels. The air release valve shall be prevented from opening at temperatures in excess of 100°C allowing the removal of air but preventing the release of steam when operating at high temperatures. The Unit shall be rated at 180°C. A tail pipe shall be run from the vent outlet to allow a tail pipe to be run to discharge in a safe environment.

320.050 EXPANSION VESSELS AND AUXILLARY VESSELS INSTALLATION:

Install vessels in accordance with manufacturer's recommendations.

Comply with the requirements of BS EN 12828 where applicable and the Code of Practice for design and installation of solar heating systems for domestic hot water - BS 5918

10000 Based on NES T15 TEXT Dec 19

Incorporating U60

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES

To provide individual and locally controlled cooling (or cooling and heating) to the areas listed in the scope of works, using units located within the spaces requiring a cooled atmosphere.

100.020 DESIGN PARAMETERS / STANDARDS

See Schedule of Common Design Criteria.
Refrigerants to have an Ozone depletion Potential (ODP) of Zero.
All components of the refrigeration system to be designed and installed to the requirements of BS EN ISO 12100, BS EN 378 Parts 1-4 - Refrigeration systems and heat pumps – Safety and Environmental requirements, BS EN 12693 (Safety and environmental requirements of refrigerating systems and heat pumps) and BS EN ISO 4126-1.
Comply with BS EN 14825 for testing and rating at part load conditions and calculation of seasonal performance.
The F-Gas Regulations 2015 as amended and relevant DEFRA guidance documents
The Pressure Systems Regulations, The Pressure Equipment Regulations 1999.
The latest edition of the relevant Institute of Refrigeration (IOR) Safety Code of Practice for refrigerant used in the installation.
The IOR Code of Practice for the Minimisation of Refrigerant Emissions from Refrigerating Systems
Systems to be designed to achieve a refrigerant leakage emission of no greater than 1% per year.
The Non Domestic Building Services Compliance Guide referred to in ADL1 and ADL2A/B of the latest edition of Part L of the Building Regulations:

PART 3 SPECIFICATION CLAUSES SPECIFIC TO T70

300.000 PRODUCTS/MATERIALS

See Scope of Works and Schedules
Electrical supply to BS EN 60038

300.001 PRESSURE EQUIPMENT DIRECTIVE/PRESSURE EQUIPMENT REGULATIONS:

All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 2014/68/EU, implemented in the UK through the Pressure Equipment (Amendment) Regulations 2015 and The Pressure Equipment (Safety) Regulations 2016, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.

Only relevant equipment and assemblies certified as compliant will be permitted under this specification, and any substitution put forward must also be compliant with the Directive.

300.015 REFRIGERANTS:

CFC and HCFC refrigerants are prohibited and must not be used.
The project DX systems are to be R32.

On applicable projects and detailed elsewhere, comply with BREEAM requirements below to suit the type of construction and scheme.
BREEAM New Construction 2018 Requirement
Comply with Issue ID Pol 01 Impact of Refrigerants.
BREEAM Refurbishment and fit-out 2014 requirement
Comply with Issue ID Pol 01 Impact of Refrigerants.

300.017 ECODESIGN / EER REQUIREMENTS FOR AIR CONDITIONERS:

Equipment to be in accordance with The Energy Related Products Regulations 2010 as amended
Fans incorporated into plant with electric input between 125W and 500kW to comply with EU Regulation 327/2011.
Units with a rated capacity of up to 12kW to comply with EU Regulation 206/2012.
Other plant to comply with EU Regulation 2016/2281 for seasonal space cooling energy efficiency and product information / instruction manuals.

The full load (cooling) Energy Efficiency Ratio (EER) of plant shall be as detailed elsewhere in this specification but shall not be less than the minimum values given in the latest edition of the appropriate Non-Domestic Building Services Compliance Guide.

300.021 COOLING / HEAT PUMP UNIT:

Standards

Relevant parts of BS EN 378, all relevant parts of BS EN 14511 and BS EN ISO 4126-1.
BS EN 12693 for safety and environmental requirements of positive displacement refrigerant compressors.
Comply with BS EN 14825 for testing and rating at part load conditions and calculation of seasonal performance.
BS EN 60335-2-40 for safety of air-conditioners and heat pumps.
Acoustic - determine sound power levels in accordance with BS EN 12102-1

On applicable projects as described in scope of works comply with international standards.
BS ISO 5151 for non-ducted air-cooled air conditioners and air-to-air heat pumps.
BS ISO 15042 for multi-split systems, modular multi-split systems and modular heat recovery multi-split systems.
Relevant parts of BS ISO 16358 for testing and calculation of seasonal performance factors

Casing

Manufacture casing from galvanized sheet steel in steel frame. Seal joints to prevent air leakage. Line casing with thermal and acoustic insulation.
Manufacturer's standard finish.

Access

Provide access to components requiring regular maintenance via access panels with special locks or hinged access doors.

Cooling unit components

Fans

Provide fan, motor and drive assembly mounted on a base frame. Isolate base frame to prevent transmission of vibration to unit.
Supply double inlet, double width forward curved centrifugal fans.
Drive fans from motor by multiple vee belts and pulleys keyed to shaft. Provide means of tensioning belt drive via sliding base.

Cooling section

Provide cooling coil manufactured from copper tube with aluminium fins.
Provide condensate drain pan with drain connection.

Filters

Provide return air filter - BS EN ISO 16890 coarse 50% unless scheduled otherwise.

Accessories

Condensate pump wired to disable the unit in the event of a pump failure

300.030 REMOTE AIR COOLED CONDENSING UNIT:

N/A

300.040 INTEGRAL COMPRESSOR UNIT:

Where specified, supply a fully hermetic compressor and fan mounted within the casing of the air conditioning outdoor condensing unit.
Provide compressor complete with suction and delivery valves, service connections and high and low pressure switches. Mount compressor on anti-vibration mountings to prevent the transmission of vibration. Fit a crankcase heater to prevent migration of refrigerant.
Ensure unit complies with BS EN 378, BS EN 12693, BS EN 14511and BS EN ISO 4126-1.
Comply with BS EN 14825 for testing and rating at part load conditions and calculation of seasonal performance.

300.046 CONTROL SYSTEM:

Refer to schedules and W60 for details
Locate room thermostats in position representative of ambient conditions on a north facing wall out of direct sunlight.

Configure controls to ensure that cooling and heating cannot operate simultaneously. Ensure heating is off before cooling operates.
Provide a 24 hour/7 day timer.

300.053 WINDOW/WALL MOUNTED AIR CONDITIONING UNIT (wasU60:300.020):
N/A

300.061 REFRIGERANT PIPEWORK
Material
Refrigerant quality copper to BS EN 12735-1, fully annealed and internally degreased and cleaned. Tubes for equipment to BS EN 12735-2.
Jointing
Do not used screwed joints in pipelines, except for connection to equipment.
Brazing - comply with British Refrigeration Association (BRA): Specification & Procedures for Manual Torch Brazing and Brazer Assessment
Insulation
On internal pipelines, insulate suction pipe from evaporator to compressor.
On external pipelines, insulate both suction and discharge pipes and protect from solar radiation where pipework is not otherwise shielded.

300.062 REFRIGERANT PIPEWORK INSTALLATION [U60:320.020]:
Comply with relevant Institute of Refrigeration (IOR) Safety Code of Practice for refrigerant used in the installation.

Arrange all exposed pipe runs to present neat appearance, parallel with other pipe or service runs and building structure, subject to gradients for draining or venting.

Ensure all vertical pipes are plumb or follow building line.
Support all pipework pipework and controls cabling throughout their length using cable tray, firmly fixed to the building fabric.
Space pipe runs in relation to one another, other services runs and building structure, allow for specified thickness of thermal insulation and ensure adequate space for access to pipe joints, etc.
Take precautions to prevent the discharge of refrigerant gases to atmosphere.
All refrigerant pipework insulation at low level or in locations where mechanical damage could occur or which could be damaged by UV radiation shall be suitably protected.

Where regulations permit supply the split system fully charged with refrigerant and with an oil charge sufficient for the effective and efficient operation of the compressor.

Ensure the completed installation is installed in line with manufacturer recommendations. Carry out strength and leak pressure tests on completion of installation. Evacuate the system and ensure that the system holds a vacuum for a period of 12 hours prior to charging with refrigerant. Submit a method statement to the Engineer for review and comment prior to pressure testing, evacuating or charging.

300.064 DRAINAGE PIPEWORK [U60 300.120]
Provide condensate drainage pipework from all units that could have wet coils to drain.
Refer to schedules and / or scope of work for details, extent of pumping and type of system.
Copper tube to BS EN 1057, fittings solder, Install tees rather than bends to allow cleaning.
Or unplasticised PVC to relevant parts of BS EN ISO 1452.
Provide tundish and air break at units.
Provide trap - depth minimum 1.5 times negative pressure on inlet and 0.5 times negative pressure at discharge
Provide an air break between trap outlet and drainage system. Pipe each trap to drain via a tundish or pipe each trap separately to discharge over a gully to prevent the potential of cross contamination between AHU's.

310.000 WORKMANSHIP

310.010 INSTALLATION:
Install equipment in accordance with manufacturer's recommendations.

T70 – Local Cooling Units / Heat Pumps

Comply with relevant Institute of Refrigeration (IOR) Safety Code of Practice for refrigerant used in the installation.

10000 Based on NES T70 text Dec 19 and NES T14 / U60 TEXT June 18

U10 – Ventilation Supply/Extract

Incorporating U11 (toilet ventilation), U12 (kitchen ventilation), U13 (car park ventilation) T40 (Warm air heating from central ventilation plant)

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES AND REGULATIONS / STANDARDS

To provide an air movement system to ventilate the spaces listed and to remove vitiated air where indicated.

To temper and filter the air where indicated or provide space heating from central ventilation plant (refer to Y40 for air handing units details)
Refer to clause W60 320.101 for control panel design, construction and installation, W60 320.091 for cabinets for BMS equipment design and construction and W60 320.102 for fireman's override fan control panel.

Comply with Building Regulations Approved Document F1 (England and Wales) or Building Standards Domestic or Non Domestic Technical Handbooks, Section 3.14 (Scotland) or Building Regulations Technical Booklet K (Northern Ireland).

Comply, as detailed in the scope of works and schedules (including Y40sch and A13sch), with the requirements of BS EN 16798-3 and additional guidance in PD CEN/TR 16798-4 to achieve the specified category of supply air (SUP) with defined category of outdoor air (ODA).

Comply with BS EN 15423: Ventilation for buildings. Fire precautions for air distribution systems in buildings.

Kitchen ventilation (U12)
N/A

Car park ventilation systems (U13)
N/A

The cables selected for power and control wiring for the installation shall be fire-resistant meeting the requirements of BS 8519.

Schools
N/A

Offices

Where applicable, comply with the top of the range recommended in the British Council for Offices Guide to Best Practice in the Specification of Offices.

Healthcare buildings

Where applicable, comply with the requirements of HTM 03-01 Specialised ventilation for healthcare premises (England, Wales and Northern Ireland).

General

Undertake checks and tests in order to verify the fitness for purpose of the installed systems prior to handover in accordance with BS EN 12599.

Refer to Y30sch1 for each ventilation systems cleanliness quality class to BS EN 15780 and PDI level to BESA TR/19

For residential ventilation comply with BS EN 13142 for performance characteristics. Performance test ventilation components/products in accordance with relevant parts of BS EN 13141.

100.020 DESIGN PARAMETERS / REQUIREMENTS

General

See Schedule of Common Design Criteria / clause 100.010.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO U10

300.011 TOILET EXTRACT UNIT (U11 300.010)

Electrical safety to BS EN 60335-2-80.
Motor - Electrical supply to BS EN 60038, type as scheduled
Access - provide access via removable panel.
Controls - On/off with auto changeover.
Accessories

Backdraught dampers.
Anti-vibration mounts.

Testing

Where fans approved under CAME scheme are used provide certified data for type.
Where fans are not approved under CAME scheme provide results of aerodynamic performance tests in accordance with BS EN ISO 5801; noise tests in accordance with BS EN ISO 5136, BS ISO 13347 parts 1-4; and fan vibration tests in accordance with BS ISO 14695.

300.015 ECODESIGN REQUIREMENTS FOR AIR HEATING PLANT: (T40)

Equipment to be in accordance with The Energy Related Products Regulations 2010 as amended.
Plant to comply with EU Regulation 2016/2281, including Seasonal Space Heating Energy Efficiency (SHEE) and product information / instruction manuals information on disassembly, recycling and/or disposal.

300.020 NATURAL VENTILATION TERMINAL UNIT MANUFACTURER:

N/A

300.040 INTEGRATION, CONTROL AND MONITORING: (U13 car park ventilation)

Provide an integrated system as detailed in the scope of works / schedules.
Equipment to be controlled / monitored should interface with BMS and fire alarm system as described in the scope of works via:

Local outstations and/or local control panels

Supervisory control and data acquisition system via:

Local outstations / control panels

Fire detection and alarm system:

Ensure interfaces to fire detection and alarm system comply with the requirements of the relevant parts of BS 5839 and BS 7273
Ensure relevant equipment complies with BS EN 50130-4.

300.050 SOFTWARE: (U13 car park ventilation)

N/A

310.000 PRODUCTS/MATERIALS

Provide system components as indicated on drawings and schedules

Natural ventilation (NES U10: 310.010 – 310.040)

Where natural ventilation terminal units include automatic controls, a manual override should be fitted to allow short-term adjustment during unexpected weather conditions.
All natural ventilation terminals to include insect screen and weather protection.
Louvres to comply with Y46 and be tested in accordance with BS EN 13030.
Air transfer devices and trickle ventilators to comply with BS EN 13141-1 for performance testing of externally and internally mounted air transfer devices and BS 6375-1 for performance for weather tightness.
Test local wall ventilators and trickle ventilators to demonstrate they comply with BS EN 1026 and BS EN 1027 for air permeability and water tightness.

Air permeability 0.25m3/hr at 50Pa in closed position unless detailed otherwise in scope of

work
Water tightness - no leakage at 1000Pa in closed position unless detailed otherwise in scope of work

Sound reduction – weighted element normalised difference to be rated in accordance with BS EN ISO 717-1. Refer to scope of works for project specific requirements.

310.005 MAIN CAR PARK EXTRACT FANS (U13 310.005):
N/A

310.006 CAR PARK MAKE UP AIR HANDLING SYSTEM (U13.310.006):
N/A

310.012 CAR PARK VENTILATION SYSTEM AND IMPULSE JET CAR PARK VENTILATION UNITS (U13 300.001, 300.010, 300.015 & 310. 010)
Refer to schedules for duties / details.
N/A

310.015 DUCTWORK SYSTEM FOR CAR PARK VENTILATION (U13 310.015):
N/A

310.016 KITCHEN VENTILATION CEILINGS (U12 310.030):
N/A

310.017 TREATMENT OF AEROSOLS/POLLUTION IN KITCHEN EXHAUST SYSTEMS (U12 310.032):
N/A

310.031 DUCTWORK FOR KITCHEN VENTILATION SYSTEMS (U12 310.030)
N/A

310.032 GROUND –AIR HEAT EXCHANGE SYSTEM - PIPEWORK / DUCTS (NES 230.085)
N/A

310.041 KITCHEN VENTILATION GAS SAFETY INTERLOCK FACILITIES (U12)
N/A

320.000 WORKMANSHIP

320.010A INSTALLATION AND COMMISSIONING (NATURAL / MIXED MODE BUILDINGS/ RESIDENTIAL):
N/A

320.011 EQUIPMENT INSTALLATION
Install equipment in accordance with manufacturer's recommendations.
Install and commission LEV systems in accordance with the latest edition of Health and Safety Executive HSG258.

320.012 PROTECTION (U13 car park ventilation)
N/A

320.020 KITCHEN CANOPY AND INSTALLATION (U12)
N/A

320.020A SYSTEM PROOVING / POST COMMISSIONING (NATURAL / MIXED MODE BUILDINGS:
N/A

320.022 INSTALLATION OF CAR PARK SMOKE CONTROL SYSTEM (U13 320.010):
Install, commission and test the car park smoke control equipment in accordance with manufacturer's
N/A

320.023 QUALITY CONTROL (U13 320.020):
Record all commissioning measurements and tests and site modifications to hardware or software, and revise operating and maintenance instructions accordingly.
Manage configuration of software settings, data and design, in accordance with an appropriate Configuration Management Plan (CMP), complying as necessary with BS EN ISO 9001, BS ISO 10007, BS ISO/IEC/IEEE12207 and BS ISO/IEC/IEEE 15288.
Provide configuration details along with the operation and maintenance manual on hand-over.
Manage information security of systems, software and data during design, implementation and commissioning in line with BS EN ISO/IEC 27001.

10000 Based on NES U10 TEXT Dec 19
U11 TEXT June 17
U12 TEXT Dec 18
U13 TEXT Dec 19

W60 – Central Control / Building Management System

PART 1 SYSTEM OBJECTIVES

This work section is derived from the BSRIA Standard Specification for BMS – Application Guide AG 9/2001. It must be read in conjunction with all the appropriate work sections, schedules, **controls drawings** and Y reference specifications. Particular attention should be made to A 37 for Operation and Maintenance Manuals / training requirements and to Y51 for Commissioning and handover requirements.
Refer to Y60 for conduit and cable trunking
Refer to Y61 for cables and wiring
Refer to Y63 for support components – cables
Refer to Y71 for switchgear and distribution boards
Refer to Y72 for contactors starters and drives
Refer to Y92 for motors
Refer to W51 for LV earthing and bonding

Controls drawings
The Controls tender drawings show schematic details of all main plant items and associated control components. They indicate the conceptual arrangement of the plant with each item identified together with a description of the controls operation and details of the associated interlocking. Where terminal units are included on the controls diagrams they show the "typical" control requirements for each unit. The Controls Specialist shall establish actual quantities of terminal units and associated control components from the detail design drawings and/or equipment schedules before production of Controls Logic diagrams as defined in work section A31 or A64 or A64D of this specification.

100.011 PERFORMANCE OBJECTIVES:
To provide a control system for the operation of services and equipment, the collection of information on operational settings and status, and where appropriate, process data for the management and operation of the building.

To provide all power wiring and containment to mechanical plant from main distribution boards or MCC's, all power wiring and containment to lighting in packaged mechanical plant such as air handling units, all control wiring / containment (including local controls serving plant not controlled by the BMS – eg local extract fans) and all interlocks between plant and safety systems including automatic shut off valves in gas supplies.

To install final power supply wiring / containment between local mechanical plant and fused spurs provided by the electrical contractor (including fan coil units, local fans, window mounted fans, local heaters etc)

To make all digital and analogue control interfaces between the BMS and packaged plant, energy / utility services meters and motor inverter drives as detailed on the Controls diagrams and individual plant schedules and elsewhere in the specification. Any apparent discrepancy between the specification / plant schedules and drawings shall be drawn to the attention of the Contract Administrator before or with the tender submission. Otherwise the Contractor shall be deemed to have made the maximum allowance within their tender.

For all buildings with a total usable floor area greater than 1000m^2 and as described in the scope of works, provide all necessary software and hardware for automatic readings of all energy and utility supply meters. The software shall be capable of real time analysis of the data. The consumption data shall presented as profiles and reports to enable consumption data to be audited against targets and consumption profiles.

To hard wire interlocked chilled water primary pumps with chiller controls to prevent operation of the chiller if the pumps are not operating.

100.020 DESIGN PARAMETERS:
Controls/BMS supplier/installer shall provide a schedule of site conditions including security, cleanliness, weather protection etc. that must be maintained before equipment is delivered.

100.023 OPERATING CONDITIONS:

Unless otherwise indicated equipment shall be suitable for operating within the following environmental ranges:-

Operator facilities	-	located in general office areas	
		Temperature -	10°C to 35°C
		Humidity -	20% RH to 80% RH
Operator facilities		located in plant areas	
		Temperature -	0°C to 50°C
		Humidity -	10% RH to 90% RH
Electrical environment		:as associated with building services plant room areas. :protected against effects of conducted and radiated interference to IEC 801 Part 3 (1984) and Part 4 (1988)	
Dust and dirt		:as associated with the indicated location of the equipment.	

The overall installation shall be capable of maintaining conditions within the following accuracies:

Temperature	+/- 0.5 °C
Humidity	+/- 5% RH

100.024 POWER SUPPLIES:

The supply to the distribution boards/MCC's shall be 400 Volts, 3 phase, 50 Hertz, 4 wire, TN-S.
Unless otherwise indicated ensure all control equipment operates normally from a power supply of:
Voltage - 230V +10%/-6%
Frequency 50Hz +/- 1%

100.025 EXPANSION

Arrange system to allow 25% expansion without redundancy.(ie: by addition rather than replacement of hardware), without compromising the BMS system's functionality or speed of operation.

100.026 COMMISSIONING

Commissioning requirements for the automatic controls systems / BMS are given in clause 350.000 and work section Y51. (also refer to A33 or A64 or A64D).

PART 3 SPECIFICATION CLAUSES SPECIFIC TO W60

300.000 GENERAL

300.010 SYSTEM REQUIREMENTS:

Select control components and equipment, suitable to meet system objective requirements. Ensure that system safety complies with:

- BS EN 61508-series for control of systems where an assessed safety integrity level is required.
- BS EN ISO 13849-1 and BS EN ISO 13849-2 for safety-related components of control systems.
- BS EN 13850 for design of emergency stop functions.
- BS EN 61511-1 for functional safety of programmable controllers.

Comply with BS EN 15500-1 for electronic individual zone control equipment.

Comply with relevant parts of BS EN 60730 for automatic electric controls.

Comply with the following standards for building automation and control systems (BACS) components:

- BS EN ISO 16484-2 for hardware
- BS EN ISO 16484-3 for functions

Comply with the requirements of the relevant parts of BS EN 50491, and BS EN 63044/BS EN IEC 63044 appropriate to the project, for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS).

Install all switches, controls, outlets and meters and all other items that require access in accordance with the relevant part of BS 8300: Design of an accessible and inclusive built environment.

Ensure that the system is designed and implemented to comply with BS EN 16947-1 and PD CEN/TR 16947-2 for overall alarming, fault detection and diagnostics, reporting, monitoring, energy management functions, functional interlocks and optimizations to set and maintain energy performance of buildings.

300.020 CONTROL SYSTEM:

Provide a Building Management System (BMS) to meet the particular requirements detailed in the scope of works and / or control strategy diagrams and schedules. Scope to include, equipment design, development of design, supply, installation, commissioning, setting to work, operator training, fine tuning and seasonal commissioning during the defects period.

Supply and install control equipment to provide a means of controlling and indicating the performance of other systems within set criteria and varying their criteria as required from a central location.

300.030 CONTROLS SPECIALIST:

Use a controls specialist to design, supply, install, test and commission complete controls / BMS installation.

300.051 COMPRESSED AIR:

Where required the compressed air plant is specified in work section S30. Ensure the compressed air is N/A

300.060 CONTROL COMPONENTS MANUFACTURER:

Unless otherwise indicated use control components and equipment from one manufacturer throughout.

300.091 FINISHES:

Ensure all equipment is designed to common installation practices. Provide all equipment as a matching suite.

300.100 ELECTROMAGNETIC COMPATIBILITY:

Ensure all monitoring system equipment is compatible, and does not adversely affect any other equipment installed in the same location.

Ensure all systems are designed and installed with due consideration to good electromagnetic compatibility (EMC) practice, and in line with EMC requirements of relevant standards including:

- BS 7671 (IET Wiring Regulations)
- BS EN 50310 for earthing and bonding in relation to communications system components
- BS EN 50174-series for communications and control cabling
- BS EN 61000-6-7 and BS EN 61000-1-2 as relevant for EMC in relation to functional safety

Ensure all equipment complies with BS EN 50130-4 where relevant.

Ensure fire alarm interface equipment complies with BS EN 50130-4 where relevant.

300.130 INTEGRATED SYSTEM:

Provide integrated system combining the sub-systems as scheduled or described in the scope of works into the BMS.

Ensure interfaces comply as necessary with relevant parts of BS 5839 and BS 7273.

300.132 BREEAM / WELL REQUIREMENTS:

On applicable projects and as detailed elsewhere, comply with BREEAM requirements below to suit the type of construction and scheme.

Provide the following unless detailed otherwise elsewhere.

A plasma screen for wall mounting installation in the building reception.

Software within BMS, to give as a minimum, a real-time display of

How much energy is being generated from all renewable energy systems and how much non-renewable energy is being consumed. Information to be gathered from all pulsed output energy usage over the same period.

Energy usage/generation of past year or month.

If a rainwater collection or grey water collection system is installed, how much water has been collected over a previous time period and what contribution this makes to the building overall usage over the same period.

BREEAM New Construction 2018 requirements

Comply with Issue ID Man 04 Commissioning and handover
Comply with Issue ID Man 05 Aftercare
Comply with Issue ID Ene 02 Energy monitoring
Comply with Issue ID Wat 02 Water monitoring
Comply with Issue ID Wat 03 Water leak detection
Comply with Issue ID Pol 01 Impact of refrigerants

BREEAM Refurbishment and Fit-out 2014 requirements

Comply with Issue ID Man 04 Commissioning and handover
Comply with Issue ID Man 05 Aftercare
Comply with Issue ID Ene 02 Energy monitoring
Comply with Issue ID Wat 02 Water monitoring
Comply with Issue ID Wat 03 Water leak detection
Comply with Issue ID Pol 01 Impact of refrigerants

Where the building is being assessed to the WELL Building Standard v1 comply with feature

Comply with feature 18 Air Quality Monitoring and Feedback
Comply with feature 23 Advanced Air Purification

310.020 GENERAL REQUIREMENTS - ELECTRICAL SAFETY:

Ensure that the BMS complies with the following legislation:

The Electrical Equipment (Safety) Regulations 2016
The Construction Products Regulations 2013
The General Product Safety Regulation 2005

Ensure that the BMS installation complies with BS 7671.

Ensure that control panels comply with:

Relevant parts of BS EN 61439-series.

BS EN 60204-1 where the control panel is classed as Machinery in accordance with the Supply of Machinery (Safety) Regulations 2008 as amended.

310.020 GENERAL REQUIREMENTS - ELECTRICAL SAFETY:

Ensure that the BMS complies with the following EC Directives

Low Voltage Directive 73/23/EEC and amendments 93/68/EEC.
Construction Products Directive 89/106/EEC.
General Product Safety Directive 92/59/EEC.

Ensure that the BMS installation complies with BS 7671 Electrical installations in buildings.

Ensure that control panels comply with BS EN 61439-1 Low-voltage switchgear and control assemblies.

310.030 GENERAL REQUIREMENTS - ELECTRICAL SUPPLY:

Ensure that the BMS can be supplied with electricity conforming to:
The Electricity Safety, Quality and Continuity Regulations 2002 (as amended); and
BS EN 50160 Voltage characteristics of electricity supplied by public distribution systems; and
Additional voltage drop within the consumer's electrical installation according to BS 7671 (IET Wiring Regulations).

310.051 GENERAL REQUIREMENTS - EMERGENCY RESTORATION PROCEDURES
Ensure that the BMS fully restores all control and monitoring functions following an emergency shut down period.
Ensure that the start delay times can be adjusted according to the magnitude of the load.
Ensure that the system restart does not cause unsafe operating states.

310.061 GENERAL REQUIREMENTS - UNINTERRUPTIBLE POWER SUPPLY FACILITY:
N/A

310.070 GENERAL REQUIREMENTS - TIME SYNCHRONISATION:
Ensure that all time-dependent BMS components are time synchronized.
Ensure that the BMS can automatically handle daylight saving adjustments including changes between British Summer Time (BST) and Greenwich Mean Time (GMT)
Ensure that the BMS can accommodate time adjustments such as leap years and leap seconds.
Refer to scope of works for any project specific detailed requirements.

310.080 GENERAL REQUIREMENTS - SYSTEM SECURITY:
Standard - IET Code of Practice for Cyber Security in the Built Environment.
Provide, as a minimum, operator access for the following levels based on user's login credentials

Level 1 - Ability to display all point data.
Level 2 - Ability to display all point data and to initiate data logging functions.
Level 3 - Ability to display all point data; to initiate data logging functions; and to change set points and time schedules.
Level 4 - Ability to display all point data; to initiate data logging functions; to change set points and time schedules; and to change control strategies and schematic/graphics functions and password assignment.

Ensure that appropriate credential-based operator and maintenance technician access is set up for clients, servers and field controllers.
Login access type to be via password unless detailed otherwise in the scope of works
Manage information security of systems, software and data during design, implementation and commissioning in line with BS EN ISO/IEC 27001.
Ensure that the BMS software is protected from unauthorised entry.
Ensure that the BMS can be maintained by a service provider with BS EN ISO/IEC 27001 and BS ISO/IEC 20000-1.

310.091 GENERAL REQUIREMENTS - SYSTEM SOFTWARE:

SOFTWARE DEVELOPMENT:
Prior to commencing the development of project specific software confirm the following information

: operating system, revision and issue number
: other packaged software to be provided, revision and issue number
: availability and cost of any further appropriate packaged software not specifically specified.
: functional description of any software needed to be written for "The Works", procedure for its preparation and development period. Provide summary of previous experience of writing similar software.
: details of software support service available to client, where future software would be written and how charged.

Demonstrate the operation of all software for conformity with the specification prior to installation.

Procedures for modifying the configuration, graphics pages and parameters shall allow alterations and additions to be made systematically without the need to shut down the BMS or any Engineering Systems.
All software shall support, without modification, the future addition or removal of outstations or points up to the practical limit of the installed software.

Obtain on behalf of the end users all appropriate licences, 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. Provide documentation for application software in accordance with BS ISO/IEC 26513 and BS ISO/IEC 26514.
Ensure that, as far as practicable, all software is commercially available off-the-shelf.
Ensure that any programmable configuration, customisation, and bespoke software, is developed, tested and commissioned using relevant processes and procedures complying with BS ISO/IEC/IEEE 12207 or BS ISO/IEC/IEEE 15288, supported by a quality management system meeting the requirements of BS EN ISO 9001.Ensure that IT industry standard operating systems are used.
Ensure that copies of all BMS vendor-specific software are held by an independent third party and that this software can be released to the client.
Ensure that the ESCROW Agreement is completed and signed.
Use communications protocol to relevant parts of BE EN 14908.

310.093 GENERAL REQUIREMENTS - CHOICE OF CONTROL STRATEGY:
Where detailed control strategies are not provided or where design development of the control strategies provided in the tender documents is required, ensure that the selected control strategies are appropriate for the building services systems and their intended application.
Ensure that selected control strategies are robust and not over complex.
Where a novel control strategy is to be implemented, ensure that testing/evaluation is performed to confirm its suitability.
Ensure that on project where a detailed control strategy is not provided, wherever possible selected control strategies are based on those provided in the BSRIA Library of System Control Strategies: AG 7/98.

310.095 GENERAL REQUIREMENTS - DESIGN FOR COMMISSIONABILITY:
Ensure that the BMS specification details required for commissioning are made available to the BMS commissioning engineer.
Ensure that all field controllers, sensors and controlled devices are easily accessible and can be removed for testing and future maintenance.
liaise with the mechanical contractor to ensure that air handling units are provided with appropriate access doors.
Ensure that access is available to all control devices. Comply as appropriate with:
- BS EN 547-series.
- BS 7671 (IET Wiring Regulations) requirements for maintenance gangways

Ensure that the requirements of the following documents are met:
- Space and Weight Allowances for Building Services Plant - Inception Stage Design. BSRIA. TN 9/92.
- Space Allowances for Building Services Distribution Systems - Detailed Design Stage. BSRIA. TN 10/92.

Ensure that sensors are installed correctly in order to give representative readings.
Ensure that reference labels are attached to each control device.

310.097 GENERAL REQUIREMENTS - DESIGN FOR MAINTAINABILITY:
Ensure that a full O&M manual is prepared which reflects any system changes made during the installation and commissioning stages.
Ensure that adequate access to BMS equipment and components is provided.
Ensure that all components and wiring are identified by a consistent numbering system

310.100 GENERAL REQUIREMENTS - SYSTEM SUPPORT:
Ensure that a viable strategy is in place to fully support the BMS for a minimum of 10 years from the date of practical completion.

310.110 OPERATOR CLIENT / SERVER - OPERATIONAL CHARACTERISTICS:

Ensure that the control of plant is independent of the operator workstation.
Ensure that no data of a control nature is transferred between field controllers via the client / server, i.e. data relating to control strategies.
Ensure that the client / server can communicate with all addressable field controllers.
Provide complete system integrity such that the network of field controllers will continue to fully operate following a failure of the client / server.
Ensure that the appropriate control strategy configuration data can be downloaded to all addressable field controllers.
Provide a means of displaying and modifying each addressable field controller's control strategy, time schedules and set-points via the client / server.
Allow the operator to re-schedule plant operation times. Ensure that re-scheduling can be applied globally to a number of items of plant at one or more sites (or one or more controllers on one site) as selected by the operator.
Ensure that the client / server incorporates a data storage management system that warns against impending on-line storage overflow and allows for data archiving to, and retrieval from, off-line non-volatile media. Ensure that the operator is prompted at pre-defined intervals to carry out the data archiving procedure.
Ensure that it is possible to perform a complete backup of the plant comprising control strategies, set-points and logged data to the server.
Where neither network-attached storage (NAS) storage area network (SAN) or cloud storage are utilised to backup purposes by the system, provide an electronic data archival device that uses readily available non-volatile media that is appropriate for long term storage of system software, configuration data and logged data (including alarm data).
Allow the transfer of data from the system memory and other storage devices to the archive mediums, and vice versa for the preparation of reports.
Ensure that the system can be fully restored from backup data..

310.115 BMS SERVER EQUIPMENT:

Refer to scope of works for detailed requirements.
Standards

- BS EN ISO 16484-3
- BS EN 60950-1
- BS EN 62368-1

Approach - Physical server unless detailed otherwise in scope of works
Administrator interface by Remote desktop, or Local user interface or UK QWERTY keyboard.
Ensure that the processor speed of each server (or server farm) meets the data processing requirements.

310.121 CLIENT DISPLAY EQUIPMENT:

Supply and install a head end PC or PC's as specified in the scope of works and in the locations described in the scope of works or as indicated on the drawings.
N/A

310.125 PRINTER(S):

N/A

310.131 SYSTEM MONITORING AND LOGGING FUNCTIONS:

Ensure that all monitored point data can be displayed at the client. Ensure that analogue, digital and soft-points can be displayed simultaneously.
Ensure that all changes made by the operator (eg set-point changes) can be logged and identified by both operator and date/time stamp.
Provide a facility to allow the display, at the client, of 'real time' data superimposed on plant schematics with a refresh rate not exceeding 20 seconds.
Ensure that a minimum of six 'real time' data points can be displayed simultaneously, in the form of data plots, with a time delay not exceeding 20 seconds.
Provide a facility to allow the monitoring and display, on the same 'page', of common criteria/plant functions.
Ensure that any hard or soft-point log can be displayed and stored on the client.

Ensure that logs can be set up from the client and that logging times and logging intervals are user adjustable between 1 second and 24 hours or when the value changes by an amount greater than an adjustable hysteresis threshold.
Provide central operator facility with the ability to select points to be logged by the system.
Total number of logging channels available for each outstation not to be less that 20% of the total physical points on that outstation or as indicated.
Outstation memory shall be sufficient to log the equivalent of 5 days data at 15 minute intervals for 20% of the total number of physical points on the outstation.
Flexibly allocate logging memory to the points selected including to "soft" or "virtual" points.
When a log is set up allow for the following

: error indication if the maximum logging channels are exceeded
: the ability to specify the frequency and duration for which the data value is to be stored.

Each logged value shall be associated with

: point reference
: unit of measurement
: date and time measured

The system shall be able to export this information to other software packages including Microsoft Excel and Word format.
Provide a facility to allow the simultaneous display of different logged data. Ensure that this function is operator adjustable.

310.141 GRAPHICAL USER INTERFACES:

Comply with relevant standards including the following where appropriate.

BS EN 61082-1 for general schematic and information presentation
BS EN 60073 for indications and actuator states
ISO 7000/IEC 60417-series, IEC 60617 and ISO 14617-series for symbols in general.
BS 1553-1 for piping systems and plant symbols and schematics
BS 1553-2 for power generating plant symbols and schematics
BS 1553-3 for compressing plant symbols and schematics
BS 1635 for fire protection system symbols and schematics
BS 4737-5.2 for intruder alarm system symbols and schematics
BS EN 1861 for refrigerating system and heat pump symbols and schematics

Provide graphics as defined in the scope of works. The graphics shall be dynamic, and to show the following as a minimum.
Water and air temperature set points, and actual values, valve and damper positions, filter status, minimum and maximum air flows in VAV systems, plant operational status (ie on/off/alarm), metering actual data.
Provide a software library of plant schematics and symbols, the format/contents of which should be confirmed with the specifier based on samples.
Provide a facility to allow the operator to generate additional schematics and symbols using readily available drawing formats.
Ensure that the system can accommodate the addition of 20% extra graphics 'pages'.
Provide a facility to allow the operator to modify plant schematics and to generate new ones. New elements for schematics to be available on a Tool Palette and the association with data points in controller outstations to be made using drag-and-drop.
Ensure that graphics can be displayed in a layered approach (building layout graphics down to plant subsystems and components). Ensure that the operator can modify the structure of the layered approach.

310.150 USER INTERFACE - HELP AND ASSISTANCE:

Provide a facility to allow the display of help text covering all operator functions and system fault conditions.
Provide a facility to allow the display (including a hard copy) of points list (hard and soft-points) and control strategy logic schematics.

310.160 INTEGRATION WITH THIRD PARTY MANAGEMENT SOFTWARE:

Energy monitoring and targeting software

Provide a facility to allow the direct transfer of recorded energy consumption and external air

temperature readings from the BMS to the monitoring and targeting software. Ensure that real time data is available in a standard database format (e.g. SQL, ODBC, etc).

Maintenance management software

Provide a facility to allow the direct transfer between the BMS and the maintenance management software of plant run hours; number and frequency of plant starts; critical alarms requiring immediate attention; and maintenance (non-critical) alarms.

Ensure that real time data is available in a standard database format (e.g. SQL, ODBC, etc).

310.170 SYSTEM ALARMS:

Standards

BS EN 62682

Engineering Equipment and Materials Users Association publication No. 191 “Alarm Systems: A Guide to Design, Management and Procurement”.

Ensure that alarms are displayed on a rolling basis in chronological order.

Ensure that the operator can acknowledge alarms, including muting of audible or flashing annunciators.

Provide a facility to silence audible alarms or inhibit flashing annunciators without performing alarm acknowledgement.

Ensure that alarms can be inhibited for reasons of time and/or priority as selected by the operator.

Ensure that the BMS can be configured to avoid fleeting alarms, i.e. ensure that alarms can accommodate start-up and shutdown delays.

Ensure that the operator can alter the limits at which the measured values cause alarms to be triggered.

Ensure that alarms can be limited to the source items(s) of plant.

Ensure that alarm limits can accommodate sliding limits, e.g. set-point changes.

Ensure that alarms can be differentiated by means of alarm type and identification.

Ensure that alarms can be prioritised (including a high priority that will be annunciated regardless of other activity) and a low priority or information status that is only annunciated on demand.

Ensure that the time taken to receive alarms does not exceed 5 seconds

Ensure that visual, audible and printed annunciation of alarms, or any combination of these, can be selected by the operator.

Ensure that the reception and acknowledgement of alarms can take precedence over other operations. However, ensure that the reception of alarms does not hinder user log-in.

Allow the user to acknowledge alarms individually and on a group basis. Acknowledgement should include muting or flashing annunciators.

Provide distinction between active alarms whose conditions are not cleared and unacknowledged alarms.

Provide an alarm-latching facility with manual reset.

Ensure that alarm data provides condition identity; condition value; alarm source; alarm time and date; and acknowledgement status.

Ensure that the alarm file can be sorted by the above criteria.

Allow alarms to be automatically redirected to other user interfaces.

Provide sufficient data storage capability for the storage of alarms.

Ensure that any stored alarm data can be analysed in conjunction with other monitored conditions or stored logged data.

Ensure that an alarm review facility is available.

Allow the display of stored alarm data based on user definable selection criteria.

Ensure that the operator can define the requirement for acknowledgement of alarms; a time programme for annunciation of alarms to different destinations; and text messages associated with alarm conditions.

Ensure that critical alarms can be relayed by SMS text message and/or email to a distribution list of operators. The definition of a 'critical alarm' is to be wholly adjustable by the administrator.

310.175 FIELD CONTROLLERS - GENERAL:

Standard

BS EN ISO 16484-2 for hardware

BS EN 15500-1 for electronic individual zone equipment

Casing material – rigid plastic

310.180 FIELD CONTROLLERS - MODES OF OPERATION:

Ensure that the field controllers perform all control actions independently of the operator workstation.

Ensure that all field controllers can operate independently and in real time following a failure of the BMS communication network.
Ensure that field controllers can operate with the loss of shared data through the use of default values and final data reading before the loss of network communications.
Provide operator interfaces

310.190 FIELD CONTROLLERS - PHYSICAL CONSTRUCTION:

For internal plant room applications, construct field controller enclosures to give a minimum degree of protection to IP54 in accordance with BS EN 60529. Where the field controller is fitted inside a control panel that is protected to IP54 then the field controller protection can be reduced to IP41. For external applications, construct field controller enclosures to IP65.
Where an enclosure is to be provided ensure that field controller enclosures are lockable.
Ensure that modular construction is used for field controllers. Ensure that this allows the removal and replacement of devices without the need for rewiring of field wiring.
Ensure that I/O modules can be removed and replaced without the need to power down the entire modular system (i.e. I/O modules are hot-swappable).

310.200 FIELD CONTROLLERS TERMINATIONS:

Use terminals of the screw down clamp-type fixed to purpose made mountings.
Segregate into groups terminals of different voltage bands (in accordance with BS 7671).

310.220 FIELD CONTROLLERS - CONTROLLER INPUTS:

Ensure that the interfaces for the field controllers are appropriate for gathering data from sensors and devices. Ensure that the following requirements are met.

Universal inputs

Variable currents (4-20 mA), variable voltages (0-10V), variable resistances or volt-free contacts.
Ensure that the scaling tables, necessary to process inputs configured as type analogue, are resident at the field controller.
Ensure that a minimum and maximum limit value can be defined for each analogue input. Ensure that each limit is associated with a configured response.
Ensure that the field controller can detect open or closed circuit faults and raise an alarm on the operator workstation.
Ensure that the configuration tables necessary to process inputs configured as type digital are resident at the field controller.
Ensure that the configuration tables necessary to process inputs configured as type multi-state are resident at the field controller

Digital inputs

As derived from volt-free contacts (max 24 volts/20mA). Allow the interface to be selected to monitor a normally open or normally closed circuit.
Ensure that the routines necessary to process the digital inputs are resident at the field controller.

Pulsed inputs

As derived from volt-free contacts (max 24 volts/20mA) at a pulse frequency of up to 32Hz.
Ensure that the routines necessary to process pulsed inputs are resident at the field controller.
Ensure that the field controller has the following capabilities.

Storage of cumulative totals daily; weekly; monthly; yearly; and continuously.
Operator re-set facility of cumulative totals via the operator workstation.
Facility to combine counts from separate pulsed inputs.
Ability to calculate the number of pulses per unit time through addition and/or subtraction.
Ability to compare the number of pulses with preset limits on the basis of total number of pulses per unit time and the time required for a total number of pulses.
Ability to convert pulsed readings into quantifiable values.
Alarm facility based on a user-defined limit being exceeded.

Ensure that the inputs which are used to monitor fluctuating pulse rate (eg maximum demand meter for electricity) have operator adjustable limits.
Ensure that when data for pulsed inputs is recorded, the record includes both the pulse count and logging intervals for cumulative counts.

Run-time totals

Include run-time totalling routines to enable the operator to record cumulative run-time for each item

of plant selected.

Provide the operator with the option to set a different maximum run-time for each item of plant selected.

Ensure that when the maximum run-time has been reached an alarm is signalled to the operator.

Ensure that the operator workstation can be used to interrogate field controllers for a point-by- point summary of run-time totals and run-time limits.

Ensure that it is possible for the user to set an initial value of hours run other than zero.

General

Ensure that all inputs can be scanned at intervals not exceeding 1 second.

Refer to the scope of works / schedules for any special requirements for time-critical control applications.

Ensure that all inputs are protected against spurious out-of-range signals including those caused by contact noise or bounce.

Ensure that errors introduced by the analogue to digital conversion of inputs do not exceed 0.1% of the analogue value.

310.230 FIELD CONTROLLERS - CONTROLLER OUTPUTS:

Ensure that isolation between controllers and networks meet the requirements of BS EN 63044 - series.

Ensure that the field controllers' interfaces are capable of providing control signals to actuators and switching devices.

Ensure that routines are configurable, such that one or more events may be enabled in direct response to any defined logical relationship between the status of a number of physical or soft- points.

Ensure that in the event of power failure, output devices can be driven to their preset, fully open/closed position.

Provide the following interface characteristics:

Analogue output. As variable currents (4-20mA) or as variable voltages (0-10V). Ensure that it is possible to characterise analogue outputs in order to obtain a near linear response from the controlled items of plant.

Digital output. Ensure that digital outputs can be selected as 'normally closed' or 'normally open'.

Ensure that errors introduced by the digital to analogue conversion of outputs do not exceed 1 LSB.

Ensure that the field controller is capable of receiving feedback signals which allow the comparison between an output signal to a controlled device and its actual condition.

310.240 FIELD CONTROLLERS - POSITIVE FEEDBACK:

Ensure that the field controllers can include routines necessary to confirm that specific items of plant are functioning correctly. Ensure that this can be performed by monitoring physically separate but functionally related sensors, switches or transducers.

Ensure that an alarm is raised if the expected response has not been established by a pre-set time following switching on of plant. Ensure that it is possible to operate any specified standby plant. Provide the operator with a facility to adjust the pre-set time delay.

Ensure that the field controllers are capable of using measured feedback from an actuator position to give a percentage open reading.

310.250 FIELD CONTROLLERS - DATA MONITORING AND LOGGING:

Ensure that hard and soft-points associated with a field controller can be logged.

Ensure that the BMS operator can set the start/stop times and logging frequency at the operator workstation.

Ensure that logging is selectable between fixed periods or on a rolling basis.

Ensure that each log can be defined in terms of log identification (point identification); units; and date/time stamp.

Ensure that the operator can select all physical and soft-points for logging.

Ensure that the field controller has sufficient memory to log the equivalent of seven days data at 15 minute intervals for 50% of the total number of physical points on the field controller.

Ensure that the log data is to be automatically uploaded to the operator workstation / system server and stored in a standard database format (e.g.SQL, ODBC).

310.260 FIELD CONTROLLERS - ENVIRONMENTAL CONDITIONS:

Ensure that field controllers are suitable for operating normally within the following environmental ranges:

Temperature 0 to 50ºC
Relative humidity 10% to 90% non-condensing.

Ensure that the field controllers will operate in the electrical environment associated with building services plant rooms.
Ensure that the field controllers are protected against the effects of moisture, dust, dirt and gases.

310.271 FIELD CONTROLLERS - INTERNAL POWER BACKUP:

Provide internal power backup
Ensure that a rechargeable battery or capacitor, if specified, can hold the controller's volatile memory for a minimum period of 72 hours.
Ensure that a non-rechargeable battery, if specified, can maintain the controller's clock function for a period of two years.
Ensure that the battery is easily replaceable.
Ensure that the interval between battery maintenance inspections is not less than 12 months.

310.280 FIELD CONTROLLERS - MEANS OF CONFIGURATION:

Ensure that the field controllers can be fully configured directly via a laptop type computer and via the operator workstation.
Ensure that the field controllers can be configured through the use of a configuration interface with full upload and download capability.
Ensure that configuration details can be easily altered by system operators.
Ensure that access to make configuration alterations is restricted to operators with access authority through the use of passwords.
Ensure that any battery monitoring functions defined in the Particular Inspection can be met.

310.291 FIELD CONTROLLERS - USER INTERFACES:

Ensure that all field controllers can be accessed through the use of portable computers.
Ensure that access allows the display of all configuration details associated with the field controller along with:

Password protection for access with a minimum of two access levels.
Ability to display all point data (both hard and soft).
Ability to initiate and display logged data.
Ability to display and alter set-points and time schedules.
Ability to make alterations to control strategies.

As defined in the scope of works or schedules provide a panel-mounted operator interface to interrogate the field controllers. Ensure that the interface includes the ability to:

Provide password protection for access with a minimum of two access levels.
Display all physical point data.
Display and alter set-points and time schedules.
Display the current date and time.
Review and acknowledge alarms.
Display logged data in graphical format, with overlaying of up to 8 logs on a single graph.

310.295 DEDICATED CONTROLS - OPTIMISERS:

Standard - BS EN 12098-2.

310.296 DEDICATED CONTROLS - COMPENSATORS:

Standard - BS EN 12098-1, BS EN 12098-3

310.297 DEDICATED CONTROLS - TIME SWITCHES:

Standard BS EN 60730-2-7.
Provide time switches with minimum of 24 hours mains failure reserve facility.

310.301 OCCUPANT CONTROLS - GENERAL:

Ensure that the specified occupant controls can be linked to, and communicate over, the BMS communications network.
Ensure that the occupant controls can control the relevant items of plant.
Ensure that the status of each occupant controller can be viewed and overridden via the operator workstation.

Ensure that each occupant controller has a service port available that allows a laptop type computer to be connected using a suitable wired service tool. It shall be possible to disable the service port function via the password protected configuration settings for the occupant control.
When connected using the service port all controllers in the entire BMS network are to be accessible via the laptop type computer.
Ensure that the occupant controls allow:
Adjustment by the occupants of the set-points.
Definition, and adjustment by the BMS operator, of high and low limits for each set-point control.
Provide a facility to allow the global alteration of set-point and high/low limits via the operator workstation.
Provide an override facility to allow plant operation during out of hours occupation.
Ensure that the occupant controls are intuitive to use and clearly labelled.
For temperature control ensure that hot/cold and/or red/blue indication is used for the occupant interface.
For fan speed control ensure that fan fast/slow indicators are used.
Ensure the +/- symbols are not used without clarification of the controlled function.
Wall/desk mounted

310.320 OCCUPANT CONTROLS - OFFICE IT/INTRANET BASED:
Ensure that the occupant controls are TCP/IP compatible.

310.330 CONTROL FUNCTIONS AND ROUTINES - GENERAL:
Provide a facility to automatically cycle selected actuators through their full range of movement outside normal operating periods with a periodicity set by the operator (in addition to normal automatic or manual control). Ensure that the cycle finishes as one complete operation. Ensure that any alarm conditions raised during the operation are inhibited as necessary.
Provide a facility to drive actuators to their open or closed positions at the end of plant operating periods.

310.340 CONTROL FUNCTIONS AND ROUTINES - BASIC CONTROL FUNCTIONS:
Ensure that configuration routines necessary for direct digital control (DDC) are resident at the field controllers.
Provide DDC of plant through algorithms giving proportional plus integral plus derivative control (PID).
Provide two-position control.
Provide raise-lower or three-point control.
Allow the selection of either proportional control (P) or proportional and integral control (P+I) or proportional and integral plus derivative control (P+I+D) modes independently for each relevant item of plant. Ensure that proportional, integral and derivative action times can be adjusted by the user.
Allow the combination of more than one control loop by 'cascading', i.e. using the output signal from one control loop as the input signal to another control loop.
Ensure control routines provide for bumpless transfer capability when switching from manual mode to automatic mode.
Ensure that the control routines are capable of controlling the individual plant items listed
Provide a comprehensive programmable facility using a simple and easy to use program strategy tool that allows comprehensive debugging and live editing of control strategies.
If a comprehensive programmable facility is not available then a micro function block based tool may be supplied providing the following requirements are met:

Provide logic modules covering
- Logical combination of digital variables.
- Logic timer module.
- Logic readback module.
- Logic counter module.
- Logic delay module.
- Logic hours run module.

Provide the following logic functions:
- AND.
- NOT AND (NAND).
- NOT OR (NOR).
- OR.

Provide the following function modules as a minimum:

Filter (applies exponential filter with gain to input signal).
Rescale from (rescales an input of 0 to 100 to a user defined output and limits at these values).
Rescale to (rescales the input to the output of 0 to 100 and limits at 0 and 100).
Limit at (limits the output at user specified values).
Limit to (limits the output to 0 or 100 percent at values specified by the user).
Logarithm of input; Square root of input; Add to input; Multiply by input; Divide by input.
Minimum (to select the minimum value from two or more inputs);
Maximum (to select the maximum value from two or more inputs);
Average (to calculate the average value from two or more inputs).
Analogue gate (digital signal switches output between two analogue input signals).
Comparator (to compare two inputs, when input X is greater than input Y output of one is produced otherwise the output is zero).
Enthalpy (to calculate the enthalpy value from a temperature input and humidity input).
Hysteresis (changes a digital state if the input changes outside a defined band).
Analogue to digital converter (to change analogue value to binary).
Provide comprehensive debugging and live editing of control strategies.

Ensure that the program strategy tool (whether comprehensive or Macro function block based) is not restricted to the use of the systems integrator but is available for suitable trained administrators via the operator workstation.

310.350 CONTROL FUNCTIONS AND ROUTINES AND CONTROL INTERLOCKS:

Ensure that the BMS is capable of providing all control functions, routines and interlocks detailed in the scope of works, schedules and controls drawings.

Where the following standard control routines are required (as detailed in the schedules, scope of works or controls drawings) the BMS shall be capable of providing the functions detailed in BSRIA Application Guide AG 9/2001. (Part A clauses 5.3 to 5.11 inclusive)

Frost protection (see clause 310.351)
Building/plant protection
Safety interlocks
Time schedules
Plant start/stop control
Sequence control
Plant rotation control
Optimum start for heating and cooling systems
Weather compensation
Lighting control

Safety interlocks

Ensure that all safety interlocks are hardwired and have precedence over all other control functions.
Ensure that safety interlocks can only be reset manually and locally (not from the operator workstation).
Ensure that all hardwired safety interlocks have corresponding software interlocks to prevent cascading nuisance alarms.
Ensure safety interlocks operate when plant selector switches are in 'Hand' or 'Auto' mode.
Ensure safety interlocks operate when frequency inverters are selected in 'Local' or 'Auto' mode at the inverter keypad.
Ensure safety interlocks comply as appropriate with:

BS EN 61508-series for control of systems where an assessed safety integrity level is required.
BS EN 13850 for design of emergency stop functions.

Variable volume pumped systems

Control strategy to include regime to fully open and close all 2 port valves in the system on a timed basis to ensure water treatment chemicals are circulated through all terminal units on a regular basis.

310.351 FROST PROTECTION OF BUILDING SERVICES SYSTEMS AND BUILDING FABRIC

Provide frost protection routines to operate plant, pumps and / or fans and necessary control valves in order to protect building services systems and their components from frost damage.

Provide the following two stages of protection:

When the outside temperature falls to the operator set minimum frost-protection temperature, the selected pumps start and circulation is established through pipework systems and their components including all air handling unit coils in locations where the outside air temperature could be below the minimum frost protection temperature. This shall include fully opening two port control valves and motorising 3 port control valves to flow to the coil. Allow the operator to pre-select which plant is to be started. The automatic standby plant is to operate on failure of the duty plant.

Ensure that when the return temperature falls below the operator pre-set minimum, the full frost-protection facility is initiated. Ensure that for heating systems, the heat source is turned on and operated to maintain the return flow temperature above the pre-set minimum. Ensure that specified protective devices activate for other liquid systems.

Provide a facility to allow frost protection to be logged together with data and time.

Provide protection routines to operate the plant in order to protect the building fabric and its contents against the effects of low internal temperatures and of condensation.
Ensure that if the internal air temperature falls below the pre-set protection temperature, the heating system and related plant is turned on and heat supplied to maintain the air temperature at or above the protection set-point temperature.
Ensure that the building/plant protection routine overrides other control functions unless otherwise specified.
Ensure that protection operates whenever the normal heating is switched off.

310.440 SYSTEM COMMUNICATIONS - GENERAL:

Ensure that the system communications allows the full transfer of monitored, logged, alarm, backup and configuration data between the operator workstation and addressable field controllers.
Ensure that the communication protocol selected seeks to achieve error-free data transfer. Ensure that the protocol includes an error detection check; includes an error correction and/or re-try technique; limits re-transmission; and raises an alarm condition on failure.
Ensure that the available bandwidth is sufficient to avoid excessive delays in transmitting data

310.450 SYSTEM COMMUNICATIONS - COMMUNICATION DEVICES:

Ensure that connections to telecommunication systems complies with BS 6701.
Provide an ADSL link.

310.460 SYSTEM COMMUNICATIONS - COMMUNICATIONS PROTOCOLS:

Arrange the digital data interchange systems using open system protocol.
Possible applicable standards – refer to scope of works for details

- BS EN 61158-2 (fieldbus).
- Profibus (BS EN 62769-series)
- Profinet (BS EN 62769-series)
- Modbus
- Modbus over Ethernet
- KNX (BS ISO/IEC 14543-series)
- BS EN ISO 16484-5 (BACnet)
- BS EN 14908-1, BS EN 14908-2, BS EN 14908-3 and BS EN 14908-4 (LonWorks).
- Metering data exchange:
  - Smart metering:
    - BS EN 62056-series Electricity metering data exchange
    - BS EN 50491-11 HBES smart metering user display
    - PD CEN/TR 16061 smart gas meters
    - PD CEN/CLC/ETSI TR 50572 Functional reference architecture for communications in smart metering systems
- PD CLC/TS 50568-4 and PD CLC/TS 50568-8 Electricity metering data exchange
- BS EN 61968-9 system interfaces for utility metering interface and control

Ensure that the selected field level protocol can:

Run on the required communications media.
Provide a communications throughput sufficient for the intended application.
Provide appropriate network topology options.
Allow sufficient maximum physical segment length.
Allow sufficient maximum number of nodes for each physical segment and the logical network.
Provide sufficient maximum distance between nodes.
Make use of off-the-shelf network devices such as repeaters, bridges and routers.
Allow control devices to be powered from the network if defined in the scope of works
Ensure that the protocol is compatible with fully developed network configuration and management tools.

310.470 SYSTEM COMMUNICATIONS - DIRECT INTEROPERABILITY:

Ensure that each of the protocol's objects and attributes are consistent with the achievement of the specified level of direct interoperability.
Ensure that each of the protocol's arrangements for physical connection, data packaging, network management and error detection/correction are the same.

310.480 SYSTEM COMMUNICATIONS - GATEWAYS:

Ensure that the gateway can
Transfer the specified maximum number of points.
Limit loss of functionality to the level specified.
Add functionality where specified.
Ensure that the specified contingency and alarm measures in response to a failure of the gateway are met.
Ensure that the gateway can be modified in response to any future changes relating to the type and amount of data transferred over it.
Clearly define who has contractual responsibility for the implementation of the gateway.

310.490 SENSORS AND DETECTORS - GENERAL:

Ensure that all signals are compatible with interfaces fitted to associated field control devices.
Ensure that the performance of the sensors and detectors are not adversely affected by variations in power supply conditions in accordance with BS EN 50160 (with additional voltage drop in the electrical installation defined in BS 7671), or by anticipated conducted and radiated electromagnetic disturbances for the electromagnetic environment in which the sensors and detectors are to be used.
Ensure that connections to sensors and detectors are of a screw down clamp type or self-locking connectors.
Ensure that sensors, detectors and meters are installed in accordance with the manufacturer's instructions and recommendations.
Ensure that calibration conditions for meters are fully documented in the O&M manuals and clearly marked on or adjacent to the meters.
Ensure that any calibration and maintenance requirements for sensors, detectors and meters are documented in the O&M manuals.
Interface detectors and sensors with controllers and indicators via amplifiers or transmitters, where necessary.
Provide calibration certificates for all sensors used on projects where there is a validation requirement.

310.500 SENSORS AND DETECTORS - TEMPERATURE SENSORS:

Standard BS EN 60730-2-9 and BS EN 14597 where appropriate.
Sensors shall not drift by more than 0.1 °C per year, and have a hysteresis value of less than 0.05%.
Off/On thermostats for general applications shall be metal with sensor accuracy of +/- 0.5 °C and volt free contacts for derivation of low voltage status signals
Time constant
Space/outside air temperature - 300s still air.
Duct air temperature - 120s @ 1m/s.
Water - 30s @ 1m/s.

Ensure that temperature sensors comply with the minimum requirements of the following table.

Temperature sensors - minimum requirements

Fluid	*Temperature range °C*	*Sensor accuracy °C*
Air	-10 to +40	+/- 0.5
Flue gas	+30 to + 850	+/- 3.0 (0.75% of FSD above 450°C)
Chilled Water	-10 to + 30	+/- 0.25
Water	-10 to +150	+/- 0.5

310.501 AIR THERMOSTATS - ROOM TYPE:

Standard - BS EN 60730-2-9.

310.505 AIR SENSOR - INSERTION TYPE:

Use proportional type insertion sensor.

Sensor

Averaging type temperature sensor for mounting overface of air flow in an air-handling unit or in ductwork adjacent to a heating coil.

Thermistor type temperature sensor, minimum stem length 200mm for mounting in the air flow or distribution ductlines.

310.510 SENSORS AND DETECTORS - HUMIDITY SENSORS:

Standards - BS EN IEC 60730-2-13

Provide humidity sensors as follows:

no need to recalibrate within a period of at least 12 months
response time of less than 30 seconds
hysteresis value of less than 3% of the measurement range
drift not exceeding 5% of the measurement range per year
useful life span of not less than 3 years

Ensure that humidity sensors comply with the minimum requirements of the following table.

Humidity sensors - minimum requirements

Sensor	*Humidity range*	*Sensor accuracy*
Humidity	10 to 90%	+/- 5% RH

310.520 SENSORS AND DETECTORS - AIR VELOCITY SENSORS:

Standard - BS EN 60730-2-15.

Ensure that air velocity sensors comply with the minimum requirement of the following table.

Air velocity sensors - minimum requirements

Sensor	*Sensor range*	*Sensor accuracy*
Pitot static tube	3 to 80 m/s	+/- 2% of reading
Thermo-electric anemometer	0 to 20 m/s	+/- 3% of reading or +/- 0.1 m/s whichever is greatest

310.530 SENSORS AND DETECTORS - AIR PRESSURE SENSORS:

Ensure that air pressure sensors are manufactured from stainless steel and comply with the minimum requirements of the following table.

Air pressure sensors - minimum requirements

Sensor	*Sensor range*	*Sensor accuracy*
Air pressure	-	+/- 2% of reading

310.535 SENSOR AND DETECTORS - FLOW SENSORS:

Standard – BS EN IEC 60730-2-15 or BS EN 60730-2-15.

310.540 SENSORS AND DETECTORS - FLOW METERS:

Ensure that meters comply with the minimum requirements of the following table.

Flow meters - minimum requirements unless scheduled otherwise.

Meter	*Meter range*	*Meter accuracy*
Fuel flow meter	0 to 10 Hz	3% of reading

Water flow meter	less than 5:1	2% of reading
Electricity meter	-	1.5% of reading

Where a meter is used to measure the amount of energy supplied for billing purposes, the meter must be approved and stamped by NMO (National Measurement Office) or approved under the European Measuring Instruments Directive (MID 2004/22/EC).

310.545 SENSORS AND DETECTORS - LEVEL SENSORS

Provide level detectors as indicated.
Use stainless steel capacitance electrodes with PTFE insulation for liquids with minimum conductivity of 0.01 S/m.
Use stainless steel conductivity electrodes.
Use float type to BS EN IEC 60730-2-15 or BS EN 60730-2-15.
Provide indicator showing measured value at sensor. Calibrate indicators.

310.546 SENSORS AND DETECTORS – OTHER SENSORS:

CO sensors
BS EN 50291-1 for manufacture and testing of detectors designed for domestic premises.
BS EN 50292 for selection and installation of detectors in domestic premises.
CO_2 sensors.

- Operating principle – NDIR (non dispersive infra red)
- Measurement range – 0-2000 ppm, numerical resolution 1ppm
- Accuracy - +/- 1% measurement range; +/- 5% of reading (within +/- 10^0C calibration temp)
- Annual zero drift - <=/- 0.3% measurable range
- Response time – 20s with tube connection at 0.1l/min
- Operating temperature 0-50^0C

Combustible gases

- BS EN 50271 for apparatus using software and/or digital technologies and BS EN 50194-1 for combustible gases in domestic premises.
- Equipment for use in explosive atmospheres to be in accordance with BS EN 60079-29-1 and installed in accordance with BS EN 60079-29-2

Toxic gases

- Design, performance functionality and testing in accordance with BS IEC 62990-1
- BS EN 50271 and relevant parts of BS EN 45544 series for electrical apparatus for the detection and measurement of toxic gases using software and/or digital technologies.

Oxygen

- BS EN 50271 and BS EN 50104

310.550 SENSORS AND DETECTORS - SENSOR TIME CONSTANTS:

Ensure that the following sensor time constants are met.

Table 6 BSRIA AG9 Sensor time constants

Measure medium	*Time constant*
Space/outside air temperature	300s still air
Duct air temp	120s @ 1m/s
Water	30s @ 1m/s
Relative humidity	300s @ 1m/s
Light	Instantaneous
Flow - water	5s
Flow - liquid fuel or gas	5s

310.555 TRANSMITTERS:

Use transmitters to interface between sensor and controller, utilizing only one sensor.
Resistance thermal device (RTD) to BS 1041-3
Resistance thermal device (RTD) to BS EN 60751.
Thermocouple to BS EN 60584-series type .

310.561 AIR FLOW VELOCITY SENSORS / DETECTORS

Where indicated, provide multi - point, integrating measuring devices in ductwork.

The units shall be suitable for the level of filtration to be provided and complete, comprising as a minimum,

a frame work to allow it to be built into the ductwork system,
all transducers, signal processors etc, to enable it to produce a signal in a form required by the BEMS (0-10 V, 4-20mA).
in-built calibration equipment for any on board electronics
display of the sensed flow at the grid

The number of sensing points shall be capable of measuring the flow to an accuracy of +/- 5% of the sensed system volume (over the full range of operating volumes on variable volume systems) to a minimum velocity of 1.5m/s..

310.610 AIR THERMOSTATS – ROOM TYPE

Standards BS EN 60730-2-9; Type as indicated and to suit application.

310.640 AIR THERMOSTATS - FROST PROTECTION TYPE:

BS EN 60730-2-9.
BS EN 14597
For space mounting use frost protection thermostats with temperature range of 0-20ºC and with SPST switching action and electrical rating of 20 amps resistive.
For heater battery protection use frost protection thermostats consisting of a gas filled sensing element and a bulb, a directly adjustable set point and switching differential.
For compensated systems use external frost type thermostats with proportional type sensor, the whole unit being weather-proofed.
Ancillaries

Start up switching and indication
Manual or automatic reset facility as detailed in the scope of works or control strategy diagrams.

310.645 WATER IMMERSION THERMOSTATS:

Standards - BS EN 60730-2-9, BS EN 14597
Use proportional type immersion thermostats with rigid sensing elements ensuring 50mm minimum length is immersed. Use separable pockets, screwed 15mm BSP.
Install pockets in positions indicated.

310.650 HUMIDISTATS:

Differential – 4% RH
Accuracy – 3% RH

310.700 ACTUATORS:

Include position feedback devices suitable for connection to the BMS.
Ensure that actuators incorporate a disconnection device to allow manual operation of the valve or damper in the event of actuator failure.
Where line voltage actuators are used, provide local means of isolation by manual isolator or plug and socket connection.

310.705 ACTUATORS - SOLENOID TYPE:

Standard - BS EN 60730-2-8 for electrically operated water valves up to DN 50.

310.710 ACTUATORS - ELECTRONIC TYPE:

Standards

BS EN 60730-2-8 for electrically operated water valves up to DN 50.
BS EN IEC 60730-2-14 for electric actuators
BS EN 1349 and relevant parts of BS EN 60534 for actuators fitted to industrial process control valves from DN 15 up to DN 1200.

Use low voltage, high torque, electronic type actuators, including mounting brackets, adjustable linkages and necessary attachment devices.
Control mode – as described in controls narratives
Actuators, together with linkages, shall operate smoothly from fully open to fully closed positions without binding and with adequate torque to overcome resistances of bearings and fluid flow.

Clearly mark linkages with clamping position so that after maintenance or replacement the mechanism can be easily restored to its correct operating position.
Fit visual position indicators.
Electrically and mechanically protect actuators against the effects valve or damper seizure.
Incorporate disconnection device to allow manual operation in the event of actuator failure.
Where indicated or necessary for correct system operation provide a position feedback device connected to Controls/BMS.

310.716 ACTUATORS - ELECTRIC MOTOR:
Standard
BS EN IEC 60730-2-14 for electric actuators
Provide thermal overload protection with manual reset option.
Electrical requirements
Integral terminal strip or DIN plug and socket connections C/W two end of travel limit switches, with adjustable cam operation for motor de-energisation.
Mechanical requirements
Manual override, geared to prevent backdrop, position indicator.
Enclose to IP65 minimum.

310.805 MOTORISED VALVES / ACTUATORS:
Type – As described in controls narratives
Standards
BS EN 60730-2-8 for electrically operated water valves up to DN 50
BS EN 1349 and relevant parts of BS EN 60534 or BS EN IEC 60534 for industrial process control valves from DN 15 up to DN 1200
Pressure Independent Control Valve (PICV) - tested in accordance with BSRIA BTS 1/2012.
Ancillaries
Position indicator, Locking device, control device and linkage mechanisms and as required to match control function

Actuating motive power - to match control system

Valve/actuator combinations shall be capable of closing off fully. In the case of 2 port control, this shall be against the full closed head of the installed pump.

General ancillaries - Positioners, locking device and lever for manual operation / control failures

The failure position of control valves shall be as follows:
Humidifiers, heating to HWS calorifiers, and items fed by steam- closed to load (i.e. spring return)
Heating and cooling coil and frost protection - open to the load or mid-position
Others - mid-position

310.905 MOTORISED DAMPERS AND SHUTTERS:
Use motorised control dampers manufactured and installed in accordance with DW/144.

310.906 RELAYS:
Use demountable relays of the totally enclosed type having at least one spare set of changeover contacts.
Electrical terminals to be shrouded and screw down clamp
Provide indicator tags/LEDs to indicate energised state. Provide manual actuation for test purposes.

320.000 INSTALLATION

320.050 FIXING AND CONNECTION - CABLING
Plan and install all building management monitoring systems cables in accordance with the cable manufacturer's recommendations.
Label and record all monitoring cables
General
This part of the specification covers extra-low voltage wiring (as defined by BS 7671), i.e. signal and data communications wiring. For power wiring refer to relevant “Y” sections of this specification.

Install all cabling in accordance with BS EN 50173-series, BS EN 50174-series and BS 7671 (IET Wiring Regulations).

All cabling must be adequately protected from the environment through which it passes to avoid the possibility of mechanical damage and electromagnetic interference.

Install cabling and conduits associated with sensors in a manner that prevents spurious transfer of moisture and heat etc from external sources to sensing devices.

Ensure that all wiring is carried out in a neat manner by skilled operatives. Clip wiring to form a loom and route it to avoid interference with the correct operation or maintenance of other components.

Cable type and application

Ensure that the types of cable installed do not prejudice satisfactory operation of the BMS.

Ensure that the type of cables, installation and planning comply with the BMS manufacturers recommendations and the project's electrical specification.

Ensure that the cross-sectional area of cables is sufficient to ensure that sensor circuit resistance limits are not exceeded.

Ensure that the method of installation and routing of cables does not compromise the satisfactory operation of the BMS.

Ensure that the minimum separation distances between data/analogue signal cables and cables of other services (including) power cables comply as relevant with BS 7671 and BS EN 50147 series.

Identification

Ensure that all cables have identification sleeves at their terminations which combine the requirements of BS 7671 with those for specific circuit identification. Ensure that the identification is consistent with the relevant wiring diagrams.

320.060 FIXING AND CONNECTION - USE OF EXISTING CABLE AND WIREWAYS:

Confirm by testing or obtain appropriate certificates from original suppliers that any existing means of network communication is of a suitable standard for satisfactory operation of the BMS.

Ensure that any tests performed comply with relevant parts of BS EN 50174.

Ensure that the potential corruption of data cannot arise from:

- Other installations not connected to, but in close proximity to, the route of existing cabling
- Other electrical services using existing cabling
- Other adjacent cabling.

State in writing at the time of tender whether or not existing cabling is suitable.

320.070 FIXING AND CONNECTION - CONNECTION TO PLANT AND CONTROL EQUIPMENT:

General

Provide all devices and terminals necessary to connect the BMS to items of plant and control equipment.

Take account of any existing services that have to remain in continuous operation. Provide for approval, an installation and commissioning plan that identifies how the BMS equipment can be installed an commissioned without disrupting the operation of the existing building services.

Where plant and control equipment are supplied by others, provide the adequate interface and integration (physical and functional) needs for installation and commissioning requirements. Provide this information in time and in sufficient detail to enable any other installers and their suppliers to incorporate the BMS connection facilities before delivering their equipment to site.

Where plant is subject to warranty by others, obtain clearances in writing from those concerned that the proposed modifications do not invalidate the warranties.

Ensure that modifications carried out as a result of the contract are fully documented and do not affect the satisfactory operation of safety devices connected to any plant or systems affected directly or indirectly by the BMS works. Carry out proving tests to the satisfaction of the Project Supervisor.

Ensure that the use of existing relays, contactors, starters and switches as part of the BMS installation is fully documented.

Safety interlocks

Provide interlocks as scheduled to establish and maintain safe/pre-determined plant conditions under all modes of operation including loss, reduction and restoration of power.

Ensure that all safety hard-wired interlocks are wired to failsafe on loss of power, or on relay coil failure, or on open circuit, eg cable breakage.

Ensure that all interlocks use voltage-free contacts and AC or DC 24V relays and field wiring.

Complete all wiring and testing of all hard-wired safety interlocks to ensure safe and/or sequenced operation of the plant before the BMS is set to work. Arrange interlocks to prevent unsafe or out of sequence operation of the plant by the BMS.

Ensure that plant does not operate using the BMS until all interlocks have been tested to the satisfaction of the Project Supervisor.

Manual control

Provide manual control facilities to enable plant maintenance/facilities staff to operate essential plant in the event of BMS failure and for routine test purposes. Ensure that the facilities include:

Start/stop operation of the plant.

Automatic operation of motorised control devices such as valves and dampers, etc if the BMS is operating.

Manual setting of motorised control devices such as valves and dampers, etc if the BMS has failed.

Ensure that the manual control facilities do not override safety devices or hard-wired interlocks.

Volt-free contacts

Ensure that the contact materials are suitable for use in the installation and at the required voltages and currents.

Use screw down or locking spade terminals for electrical connections to volt-free contacts.

Relays

Use demountable relays of the totally enclosed type.

Use relays with circuit arrangement printed on top.

Use screw down clamp or locking spade-terminals, and ensure they are shrouded.

Use relays with LED or flag indication of coil status.

.Signalling from starters

Provide additional contacts for signalling and remote operation purposes as scheduled

Control equipment

Obtain advice from the relevant supplier when additional facilities are to be fitted to control equipment supplied by others.

Use the knockouts, cable routes and terminals, etc incorporated into the design of control devices.

Packaged plant

Ensure that connections to packaged plant are made within the packaged plant control panel. Fit an additional enclosure where this is not possible. Ensure that all connections between the BMS and packaged plant are 24V maximum.

320.080 FIXING AND CONNECTION - ADDITIONAL PROVISIONS FOR RETROFIT INSTALLATIONS:

Arrange for any necessary control modifications to existing plant to be carried out by the original supplier (with the exception of starter panels). Give the supplier details of the requirements for connection of equipment to the BMS. State the name of the supplier in the Tender together with a priced schedule for the necessary work.

Where details of existing plant are not available from the original supplier or from record documents, provide a specialist conversant with the particular type of plant to carry out any necessary modifications. Provide the specialist with the details of the BMS connections required. State the name of the specialist in the Tender together with a priced schedule for this work. Advise the Project Supervisor of any difficulties with connections.

Advise in writing at the time of tender of any potential delay to the contract arising from the difficulty of providing the necessary BMS connections to the plant.

Use existing relays and volt-free contacts where feasible.

Fit auxiliary contacts to contactors, etc where adequate space is available. Install additional relays if the space is not adequate.

Obtain advice from the original supplier when additional facilities are to be fitted to existing control equipment.

Use the control manufacturer's standard accessories to provide any additional contacts, limit switches and potentiometers, etc.

Use the knockouts, cable routes and terminals, etc incorporated into the design of control devices wherever possible. Obtain approval from the Project Supervisor for ad hoc fixings and modifications to control devices before action is taken on site.

320.091 CABINETS FOR BMS EQUIPMENT DESIGN AND CONSTRUCTION:

Construct BMS equipment enclosures to give the minimum degree of protection to IP54 and IP 55 in wet plant rooms, unless scheduled otherwise, in accordance with BS EN 60529. Where the enclosure is fitted inside another panel (eg a motor control center to IP 54 or 55) the protection can be reduced to IP41. For external applications, construct enclosures to IP 65 unless scheduled otherwise.
Ensure that access doors are of a rigid construction and mounted on stout metal hinges capable of supporting the full weight of the open door. Ensure that doors will not sag or drop when open. Fit doors with stout locking handles to prevent access by unauthorised personnel.
Allow safe access to the BMS equipment where the BMS equipment is incorporated into another control panel without having to isolate the panel.

320.101 CONTROL PANELS - DESIGN, CONSTRUCTION & INSTALLATION:

Refer to schedules or scope of works for control panel type, internal separation, input power supply and electrical ratings.

Standards

BS EN 63044-series for controllers
Relevant parts of BS EN 61439-series where the control panel forms part of switchgear and/or controlgear as defined in the standard
BS EN 60204-1 where the control panel may be considered to form part of machinery as defined in the Supply of Machinery (Safety) Regulation 2008 as amended
BS EN 60529 for ingress protection
BS 7671 (IET Wiring Regulations)
BS EN 62208 for enclosures

Control panel design

Ensure that the layout of control panels reflects the layout of the plant being served. Ensure that indicators and controls for associated plant are grouped.
Ensure that all doors on panels containing exposed dangerous voltages are provided with interlocked isolators such that the door cannot be opened except with the isolator in the 'off' position. Ensure that isolation complies with BS 7671 (IET Wiring Regulations).
Ensure that equipment that requires on-line adjustment and testing by non-electrically qualified personnel is accessible and usable without interrupting the supply or overriding safety interlocks. Ensure that in general, field controllers are not located within control panels where isolation is necessary to gain access.
Design panels to maintain all components within their environmental tolerance limits taking into account ambient environmental conditions. Install fans with thermostatic control and air extract grilles and air intake grilles with replaceable filters where mechanical ventilation is required to control the environmental conditions. Ensure that the specified ingress protection (IP) ratings are maintained.

Service conditions

Ambient air temperature to relevant parts of BS EN 61439.
Suitable for ambient air temperature for outdoor installations where required.
Altitude to relevant parts of BS EN 61439.
Suitable for use at altitudes above 1000m where required.
Electromagnetic compatibility
Environment A to BS EN 61439-1 (industrial)
Environment B to BS EN 61439-1 (domestic and light industrial)

Control panel construction

Construct control panels inside buildings to IP54 and IP 55 in wet plant rooms. For external applications, construct enclosures to IP65 unless scheduled otherwise.
Where the enclosure is fitted inside another panel (eg a motor control centre to IP 54 or 55) the protection can be reduced to IP41.
Construct the panels using sheet steel, folded and seam welded to form a rigid self-supporting structure. Ensure that bracing and stiffening is used as necessary to take the weight of internal components and control assemblies. Ensure that no sharp corners are present.
Ensure that control panels weighing more than 50 kg including installed components are fitted with eyebolts to facilitate delivery and installation.
Ensure that panels are provided with adequate undrilled and/or detachable gland plates of sufficient size and strength to accept glands for all types of cable conduits and cable trunking intended for termination within the panel.
Arrange all wiring within the panel in looms and/or perforated trunking. Ensure that all cables are run

continuously from terminal to terminal without intervening joints.

Ensure that all terminations are fully shrouded, recessed or otherwise protected against accidental contact to at least IP 2x / IP xxD

Ensure that where live equipment cannot be isolated it is covered with a perspex shield carrying appropriate warning labels in addition to specified shrouding.

Ensure sufficient spare capacity in cable ways and trunking to comply with BS 7671.

Ensure that flexible looms are used to connect door mounted to interior-mounted components such that wires will not weaken or break with repeated door openings. Arrange the loom to avoid pinching or looping when the door is closed and ensure that it is fully supported at each end.

Locks to be multipoint locking system with T-handle / key unless scheduled or described otherwise in the scope of works.

Internal wiring

Standard

BS 6231 polyvinyl chloride (PVC) insulated or BS EN 50625-3-41 low smoke zero halogen (LSZH)

BS 6701, BS EN 50173-series and BS EN 50174-series for telecommunications cables

Identification of conductors - Comply with the following standards, as relevant:

BS EN 60445 core standard for identification of conductors

BS 7671 for wiring forming part of the electrical installation

BS EN 60204-1 for control panels that are classed as a component of machinery in accordance with Supply of Machinery (Safety) Regulations 2008

BS EN 61439-series for switchgear and controlgear assemblies

BS 6701, BS EN 50173-series and BS EN 50174-series for telecommunications cables

Identification of earthing and bonding conductors

Ensure protective conductors are coloured cream and labelled in accordance with and BS 7671 and BS EN 60445.

Ensure dedicated telecommunication functional earth conductors are identified and labelled in accordance with BS 6701.

Ensure combined protective earthing and functional earthing conductors are identified primarily as protective conductors.

Control wiring

Segregate control and auxiliary contact wiring from power circuits and data communications circuits.

Provide electrical separation for voltages of different bands in accordance with BS 7671, BS EN 60204-1 and BS EN 61439- series as relevant.

Contain control wiring in slotted plastic trunking

Take account of thermal effects of grouping when routing power wiring.

Wire termination practice

Identify every wire at each end with a unique wire number according to the control panel drawings and cable schedule. Wire numbers may be formed from numbers and uppercase letters. Ensure the system used cannot be confused with alphanumeric conductor function identification requirements of BS EN 60445 and BS 7671.

Terminate wiring intended for screw terminals with ferrules to prevent damage to conductors, and facilitate fault finding and maintenance replacement of components.

Arrange all wiring within the panel in looms and/or perforated trunking. Ensure that all cables are run continuously from terminal to terminal without intervening joints.

Ensure sufficient spare capacity in cable ways and trunking to comply with BS 7671 (IET Wiring Regulations).

Ensure that flexible looms are used to connect door mounted to interior-mounted components such that wires will not weaken or break with repeated door openings. Arrange the loom to avoid pinching or looping when the door is closed and ensure that it is fully supported at each end.

Provide DIN-rail mounting for equipment and terminate to.

BS EN 60715 dimensional type designation as agreed by the designer:

Ensure steel DIN-rails are manufactured and finished in accordance with Appendix A to BS EN 60715.

Location

Do not locate outstations within control panel compartments where isolation is necessary to gain access.

Control panel labelling

Ensure that all panels and individual panel sections are provided with exterior labels to BS EN ISO 7010 and BS 7671 (IET Wiring Regulations) indicating the voltage within the panel along with clear warnings of risk and instructions for isolation. Display requirements for informing the BMS supervisor and/or disabling alarms prior to isolation of control circuits.

Label all switches, controls and indicators on control panels as to function and associated plant.

Fix a notice to the front of the panel warning of the need for isolation elsewhere if the panel does not totally control the electricity supply to associated plant.

Identify all cables with permanently fixed alphanumeric labelling system. Ensure that the numbering corresponds to the numbers fixed to the terminals. Ensure that identification and coding matches that used on the design drawings, schematics and schedules.

Lights

Use LEDs

Use lens colours in accordance with BS EN 60073.

Audible alarms

Ensure that operation of any starter trip lamp, safety circuit lamp or alarm lamp operates a common audible alarm with mute and test facilities and terminals for remote alarm signal.

When an alarm condition has had the audible alarm muted, ensure that terminals for a remote 'alarm accepted' light are energized. The audible alarm circuit and terminals for remote alarm signal must still be capable of indicating another fault occurring even though original fault has not been cleared. The test facilities are to test momentarily both the audible alarm and alarm indicator lamps, whilst the push button is depressed.

Use alarms that interface with a sensor or controller to sense set-point and measured value. Provide adjustable upper and lower limits on face of unit. Provide unit with indicating lamps to show which limit has been exceeded. Provide each unit with connections for remote alarm.

Surge and transient suppression

Ensure surge arrestors are fitted for star-connected and star-delta started motors to limit peak voltage to 1200 V.

Ensure transient suppressors in the form of resistor and capacitor networks are fitted across starter contactor coils.

Controlgear

Terminals for external conductors

For main power circuits, accommodate cross-sectional area of copper cables in accordance with BS EN 61439-1, Appendix A.

Size neutrals on 3-phase supplies to take account of harmonic content (triple-n's) where relevant, with a minimum of the full current-capacity of the corresponding phase conductors.

For control and auxiliary circuits, provide terminal blocks suitable for DIN rail mounting on top-hat rails dimensional type TH 37-7,5 to BS EN 60715.

Accessibility for inspection

Arrange for following operations to be performed when assembly is in service and under voltage.

Visual inspection of switching devices and other apparatus, settings and indicators of relays and releases, conductor connections and markings.

Adjusting and re-setting of relays, releases and electronic devices.

Replacement of fuse links and indicating lamps.

Fault location by voltage and current measuring.

Accessibility for maintenance

Provide space between functional unit or group and adjacent functional units or groups. Provide retainable fastening means for parts likely to be removed for maintenance.

Use barrier protected sub-sections for each functional unit or group.

Use compartments for each functional unit or group.

Removable parts and withdrawable parts

Degree of protection of assembly after removal or withdrawable of part as manufacturer's standard.

Mounting – As scheduled or detailed in the scope of works

Site modification

Do not make site alterations unless authorised. Where site modifications to assemblies are authorised make in accordance with manufacturer's certified drawings and instructions. Ensure that modifications made comply with type test certificate obtained for arrangement of components.

Provide document pocket inside the control panel, complete with full control panel schematic and wiring schedule.

320.102 FIREMAN'S OVERIDE FAN CONTROL PANEL

Supply and install a fireman's override fan control panel as specified in the scope of works or as indicated on the drawings.

Provide plant switches required are located under a breakglass panel which has a budget lock (ie one which accepts the keyed base of a firemans axe).
Switches shall be configured by plant as Override On/Normal/Override Off. An indicator lamp shall be provided for each position. The colour of the panel shall be agreed with the CA. Allow for stainless steel panel with all text etched and coloured. Panel to be recessed. Size / finish to match fire alarm panel as Architect's details.

320.110 SENSORS - GENERAL:

Ensure that sensors can be removed for testing and maintenance.
Ensure that a tight-sealing test hole is provided adjacent to every duct sensor. Ensure that Binder test points, or similar, are provided for pipe sensors.
Provide a sufficient length of spare cable so that the sensor can be removed without disconnecting the wiring.
Mark and record the location of concealed sensors (e.g. in false ceilings and shafts, etc).
Provide a labelling plate for each sensor.
Take account of the active and inactive sections of a sensor probe.
Take into account the effects of orientation on the functioning of the sensor.
Take into account:

- Minimum/maximum ambient temperature.
- Ambient humidity.
- Vulnerability to spray water and/or vibration.
- Explosion protection.
- External influences.

320.120 TEMPERATURE SENSORS:

Pipe-mounted immersion sensors

- Ensure that the full active length of the sensor is immersed in water.
- Install sensors against the direction of flow.
- Install at the correct angle.
- The sensor should be installed diagonally in a bypass pipe or in a bend if the active length of the sensor probe is longer than the diameter of the pipe.
- Allow an adequate space between the sensor and the obstruction so that the sensor can be removed from the immersion pocket.
- Ensure that immersion pockets are made from stainless steel of the appropriate pressure rating.
- Ensure that immersion pockets are filled with a heat conducting compound.
- A test point or an additional immersion pocket, adjacent to the sensor, should be provided for test purposes.
- An adequate distance (10 x pipe OD) between the mixing point and the sensor should be provided when mixing water at different temperatures to take account of stratification.

Surface temperature sensor - water

- Ensure a smooth clean contact surface and fill the space between the sensor and the pipe with a heat conductive compound to improve thermal conductivity.

Immersion sensors for air (ducts)

- The full active portion of the sensor probe should be exposed to the air flow.
- Ensure that the active portion of the probe is located central to the airflow.
- A test hole should be provided adjacent to every sensor with plug when not in use.
- Probe-type sensors should not be used in areas where stratification can occur, eg downstream of heating and cooling coils, etc (see averaging sensors).
- Sensors which are positioned near to coils should be shielded against the radiative heat transfer.
- Return air duct sensors should be located near to the occupied space to avoid heat gain or loss and radiant effects influencing readings.
- Sensors must be positioned in an area of representative air flow. This applies to all duct sensors but particularly the return air sensor which may be located in the ceiling plenum.
- The likely cleanliness of the air should be considered when selecting sensors.
- Sensors representing zone temperature should be offset to account for heat gains e.g. space temperature stratification or if light fixtures are used as the return air path.
- Sensors should only be used in return air ducts where air is continuously extracted.

Capillary sensors with probes

The device head must be higher than the sensor probe.
The sensor probe should be tilted downwards.
The ambient temperature at the device head must always be higher than the temperature to which the sensor probe is exposed.
The sensor element must always point downwards. The capillary should not form a U-shape.
The capillary should not be bent too tightly (radius of bend 50mm).

Averaging sensor (for use in ducts/AHU)

Allow a distance of at least 50 mm between any heat exchanger and the sensor.
The entire length of an averaging sensor must be fully inside the air-duct.
The sensor element must be evenly distributed over the full cross-section and adequately secured to prevent vibration.
The sensor element should be installed in the air flow, downstream of the eliminator plate when air washers are used for humidification.

Frost protection thermostat

Leave a spare capillary loop of 20 cm to enable sensor testing outside the duct/unit.
The measuring head and the test loop of the thermostat must be located inside the ductwork and downstream of the heat exchanger if the ductwork is outdoors or in an unheated space.
The capillary should be installed in the air flow, downstream of the first heating coil exposed to frost. The capillary must be installed diagonal to the heat exchanger pipes or in a serpentine manner at right angles to the pipes.

Room sensor

Sensors should be installed at a height of 1.5 m in occupied spaces and at least 50 cm from any adjacent walls.
Where room sensors have an adjustable dial they shall be mounted at 1.2m
The sensor should be located in an area representative of the entire control zone.
The sensor should be located away from heat sources, e.g. office IT equipment.
The sensor should be located in the area it controls.
Sensor locations near air currents generated by diffusers or openable windows, for example, should be avoided.
The sensor must not be exposed to direct solar radiation.
Avoid external walls except were unavoidable. Use insulated backplates.
Avoid recesses and alcoves.
The conduit entry points to the sensor wall box should be sealed where there is a risk of air from another zone flowing over the sensor element.
Do not install near or under lamps or above radiators.
Avoid chimney walls.
Do not install directly adjacent to doors.
Do not install behind curtains.
Do not fit to walls concealing hot-water pipes.

Outdoor air temperature sensors

Do not install on facades affected by significant rising heat, or facades which will be heated by solar radiation (fix sensors to a north-facing wall or use solar shields).
Avoid chimney walls and other walls subject to high internal heat gains.
Do not install under eaves.
Do not install above windows.
Do not install above ventilation extracts.
Ensure accessibility for inspection/verification
An alternative to an external mounting is to locate the sensor in the AHU intake duct. This should ideally be upstream of the intake damper and on AHU plant which run continuously (24/7). Where this is not possible it must be a suitable distance before re-circulated air and mechanical devices to avoid their effects.

320.130 HUMIDITY SENSORS:

Humidity sensor/stat. - duct

The air velocity in the vicinity of the sensor must not exceed 10 m/s (a perforated steel plate cover can be used).
The sensor must not be located in deadlegs (super-saturation can occur in areas where there is no air flow).
A test hole must be provided downstream of the sensor, plugged off when not in use.

The sensor should be positioned beyond the spray distance of humidifiers.

Humidity sensor/stat. - room

The sensor should be installed at a height of approximately 1.5 m in the occupied space and at least 50 cm from the adjacent wall.

Avoid locations where the sensor will be exposed to direct solar radiation.

Avoid external walls except were unavoidable. Use insulated backplates.

Avoid alcoves and recesses.

Do not install near lamps or above radiators.

Do not fit to chimney walls.

Do not fit directly adjacent to doors.

320.140 PRESSURE SENSORS:

Pressure - general

Pressure sensors are affected by orientation.

The pressure tubes must be provided with a binder point near the device head for test purposes.

The connection must be fitted with a bypass with a stop valve to avoid overload on one side when manipulating the sensors and to enable zero calibration. Isolating valves should also be fitted.

The sensor should be installed on a vibration-free surface or vibration-proof base.

The pressure-tapping point must not be located in turbulent air flow. Provide 6 x OD upstream and 6 x OD downstream of straight duct or pipe without obstructions.

Pressure - air

Probes for measuring static pressure should be installed parallel to the flow.

The differential pressure measuring tube should be correctly sized.

The tapping point should not be located where it will be affected by obstructions to the flow.

Pressure - liquids

Use a damping coil to avoid transferring vibrations (horizontal loops to avoid trapped air bubbles and condensate).

The device must always be installed in a location which is lower than the sensing point.

Do not measure at the top of a pipe (trapped air, bubbles) or at the bottom (dirt).

Pressure - gases

When measuring vapour gases the device must always be installed in a location which is higher than the sensing point.

Measure at the top of the pipe to prevent condensate from entering the pressure tube.

320.150 FLOW VELOCITY/FLOW RATE SENSORS:

Differential pressure for flow monitoring - liquids

There should be no stop valves or balancing valves between the sensing points on the pipework.

Differential pressure for flow monitoring - air

Ensure a steadying zone upstream and downstream of the orifice plate/flow grid, etc.

The flow or differential pressure must not be monitored where there is a variable resistance such as a filter or fan, etc.

Velocity sensors

Sensors should be positioned at an adequate distance from bends, tees, fans and coils such that the centre line velocity is representative of the average velocity.

A single point sensor should be located at a distance from the centre of the duct equal to 0.25 x the duct radius.

Wilson flow grid

Averaging velocity sensors across the duct, e.g. Wilson flow grid or multi-point averaging pitot tubes, should be used where the minimum separation distance from a flow disruption is not available. Ensure that the Wilson flow grid is sized correctly for each duct size.

320.160 INDOOR AIR QUALITY SENSORS:

CO_2 and mixed-gas sensors - room mounted

Ensure that the sensor is located in a representative location, e.g. on an open wall 1.5 to 3 m above the floor.

Ensure that the sensor is not mounted in niches or bookshelves or behind curtains.

Ensure that the sensor is not located where people are continuously present (within 1 or 2 metres).

CO_2 and mixed-gas sensors - duct mounted

Ensure that the sensor is located in the return air duct as close as possible to the room extract point(s).

Ensure that the sensor is located in the vertical position.

Ensure the correct orientation of the duct probe with respect to the airflow.

Ensure that the sensor is not installed in a vertical position with the head at the bottom.

320.170 ACTUATORS:

Securely mount actuators to rigid members, free from vibration or distortion in accordance with manufacturer's recommendations. Select mounting positions to require minimum linkages, and to avoid angular drive to operating levers. Allow access for servicing and replacement.

Ensure that actuators and linkages for valves and dampers operate smoothly from fully open to fully closed without binding and with adequate torque to overcome the resistance of the actuator mechanism and the flow and to provide the specified close off ratings.

Ensure that linkages are clearly marked with the clamping position such that after maintenance or replacement the mechanism is able to operate correctly.

Fit actuators with visual position indication.

Actuators shall have tamperproof reversible clockwise and anti-clockwise mode selection. Ensure that there is sufficient space above the actuator so that it may be removed for testing or maintenance.

Include position feedback devices suitable for connection to the BMS.

Ensure that actuators incorporate a disconnection device to allow manual operation of the valve or damper in the event of actuator failure.

Ensure that actuators are electrically and mechanically protected from the effects of valve or damper seizure.

Use 24v actuators wherever possible. Where line voltage actuators are used, provide local means of isolation by manual isolator or plug and socket connection.

Ensure that, during commissioning, valve actuators are fitted in a fully closed/bypass position where they are being fitted to valves which push against a spring.

320.180 VALVES:

General

Ensure that valves have the correct authority without excessive pressure drop.

Ensure that valve bodies are suitable for the medium, the temperature and the pressure of the fluid system.

Ensure control valves have a close-off pressure rating higher than the circuit pressure design.

Ensure that valves will pass the required flow at a pressure drop within the maximum differential pressure rating of the valve.

Check for out-of-balance forces, particularly during operation of a three-port valve.

Where possible ensure that valves are not installed with their spindles in the horizontal position. If valves cannot be installed with their spindles in the vertical position ensure that they are as near as possible to the vertical.

Ensure that valves are not installed with the actuator at the bottom.

Modulating valves

The following additional considerations apply for modulating valves:

Ensure system operating pressures, test pressures, pump heads and pressure drops through heat exchangers and associated pipework are known before control valves are selected.

Select 3 port valves to provide a minimum authority of 0.5 for diverting applications and 0.3 for mixing applications.

Select 2 port valves to provide a minimum authority of 0.3

Select valves with port characteristics appropriate for the intended function.

Ensure that all modulating control valves are selected for equal percentage or linear characteristics according to system type, to provide near linear characteristics between the valve position and heating/cooling power as delivered to the air or water-based system.

Ensure that the rangeability of the selected valves is large enough to provide stable control under low load conditions.

Combined pressure independent 2 port control valves (PICV)

Select, install and commission valves to provide the functions of flow limitation, modulating control and differential pressure control within a single valve body.

The valve manufacturer shall provide test results for each type and size of PICV to be used on the project in accordance with BSRIA Test Method for Pressure Independent Control Valves BTS 1/2012.

Limiting minimum operating pressure – 20Kpa.

For PICVs with a k_v value less than 0.4, a flushing drain should be incorporated in the pipework between the terminal unit and the PICV.

All PICVs' shall have an equal percentage control characteristic, be sized such that the design flow is within the setting range of the valve and be capable of closing against a maximum differential pressure that is greater than the pump head.

Type – Full stroke where the control and flow setting functions are separated within the valve and the full stroke of the valve is available for control (unless scheduled otherwise)

Valve characteristic/control - Equal percentage modulating (unless scheduled or described otherwise elsewhere in this specification).

Duties - To suit terminal unit design flow rates as detailed in equipment schedules.

Standard

Relevant parts of BS EN 60534

Valve leakage class to BS EN 60534-4 when shut off - IV.

Materials:

Body - DZR brass.

Globe or ball - brass.

Stem - brass.

O-Ring/diagram - EPDM rubber.

Springs - stainless steel.

Features - Facility to measure pressure drop across valves at commissioning.

Actuator - 0-10V proportional electric for modulating control or 3 point floating control.

320.190 VALVE SIZING REQUIREMENTS:

All types of valves and applications

Parameter - Body pressure rating.

Requirements - To exceed system test pressure.

All 2-port valves

Parameter - Close-off pressure rating.

Requirements - To exceed pump or system full differential pressure.

All 3-port valves

Parameters - Close-off pressure rating.

Requirements - To exceed out of balance pressures

All types of valves and applications

Parameters - Maximum leakage coefficient.

Requirements - 0.05% kv.

2-port isolation valves

Parameters - Pressure drop at full flow.

Requirements - Select at line size for minimal pressure drop.

2-port modulating valves

Parameters - Pressure drop at full flow.

Requirements - Select kv value for a minimum authority of 0.3, not to exceed 50 kPa.

3-port modulating valves

Parameters - Pressure drop at full flow.

Requirements - Select kv value for 30% - 50% authority against coil or circuit pressure drop.

Isolation valve

Parameter - Characteristic.

Modulating valves (plant valves and zone reheater coil valves)

Parameters - Characteristic.

Requirements - Equal percentage.

Modulating valve (fan coil units)

Parameters - Characteristic.

Requirements - Equal percentage (preferred) or linear.

Modulating valves (independently pumped mixing and injection circuits)
Parameter - Characteristic.
Requirements - Linear.
PICV's – refer to clause 320.180.

320.200 DAMPERS:
Provide visual position indicators on all damper actuators installed so that they can be seen from the plantroom floor.
Ensure that damper characteristics are as linear as possible.
Ensure that modulating dampers are sized correctly to give adequate authority.

320.210 COMMUNICATION NETWORKS - GENERAL:
Ensure that all addressable control devices can be addressed over the communications network.
Ensure that the bandwidth and subsequent speed of communications is sufficient to meet the requirements of the selected manufacturer's BMS equipment.
Ensure that no cross corruption of data occurs when the BMS shares a communication network with other IT-based systems. Ensure that permission has been given by the IT manager to connect BMS components onto the IT network. Comply with the organisation's IT strategy for connection of devices to the IT data network, including allocation of IP addresses.
Ensure that network testing, identification and documentation comply with BS EN 50173-services and BS EN 50174-series.
Ensure that all network devices such as routers and bridges are compatible with the network and are capable of operating such that the required throughput of data is achieved.
Install communication networks in accordance with BS EN 61918.
Assess the network performance for business-critical functions in accordance with BS EN 61907.

320.220 COMMUNICATION NETWORKS - STRUCTURED CABLING:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Ensure that the selected BMS components are suitable for operating on the structured cabling system.
Ensure that the selected BMS topology (star wired, chained or bus-based) is appropriate for the structured cabling system.
Ensure that each addressable BMS device can be addressed over the structured cabling system.
Where BMS components are specified to be powered from the structured cabling system ensure that the power available is sufficient. Ensure that overheating of the structured cabling system will not occur.
Ensure that any changes to the structured cabling system are reflected in updated documentation.

320.230 COMMUNICATION NETWORKS - INTRANET AND INTERNET APPLICATIONS:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Ensure that the BMS is compatible with relevant security techniques in accordance with BS ISO/IEC 27032
Ensure that the BMS devices to be directly connected onto the Intranet/Internet are TCP/IP compatible.

320.240 COMMUNICATION NETWORKS - MAINS-BOURNE SIGNALLING:
Comply with the requirements of BS EN 50065-1.
Provide the necessary equipment to ensure that there is no mutual interference between the signaling system of the electricity utility and mains-borne signaling of the BMS.

320.250 COMMUNICATION NETWORKS - RADIO COMMUNICATIONS:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Ensure that the radio transmitter/receiver and the BMS components are adequately powered.
Ensure that radio communications devices and associated BMS components are easily accessible to allow the change of batteries.
Ensure that the attenuation of radio signals does not hinder effective data communications.

320.260 INTEGRATION WITH FIRE DETECTION SYSTEMS - GENERAL:
Where specified in the scope of works, schedules and controls drawings comply with the following

requirements:
Ensure approval from the relevant Fire Prevention Officer or Building Control Officer.
Ensure that the requirements of BS 5839-1 are not compromised.
Ensure that the fire detection system can operate autonomously and will not be affected by any failure of the BMS.
Ensure that the BMS will not be affected by any failure of the fire detection system or fails safe as appropriate.
Ensure that the loss of electrical power to the BMS will have no adverse effects on the fire detection system.
Ensure that a full cause and effect testing programme is developed in conjunction with the fire alarm company.
Ensure that the integrated system is fully commissioned.
Ensure that the contractual responsibilities of the various parties responsible for the integrated system are fully defined.

320.270 INTEGRATION WITH FIRE SYSTEMS - INTEGRATION DETECTION FOR MONITORING:

Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Uni-directional systems
Provide the display of fire alarm detector status information on the BMS operator client indicating the location of fire detector heads or zones, along with their respective status
Ensure that a fire alarm condition automatically displays the appropriate building graphic/schematic along with relevant detector head status or zone status.

320.280 INTEGRATION WITH FIRE DETECTION SYSTEMS - INTEGRATION FOR CONTROLS:

Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Provide fail-safe, hard-wired interlocks using volt-free contacts between the BMS field controllers and items of plant listed in schedules.
Use volt-free contacts and AC or DC 24V interlocks.
Use relay logic and/or microprocessor-based logic.
Ensure that building services control actions operate correctly in response to the status of the fire detection system.

320.290 INTEGRATION WITH SECURITY DETECTION SYSTEMS - INTRUDER ALARM SYSTEMS:

Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Provide the display of security sensor/detector or zone status information on the BMS operator client.
Provide any building graphics/schematics on the BMS operator workstation indicating the location of security sensors/detectors or zones along with their respective status.
Ensure that a security alarm condition can automatically display an appropriate building graphic/schematic along with the relevant sensor/detector status.
Ensure that any time delay in receiving security alarm data at the operator workstation client does not exceed the manufacturer's recommendations.

320.300 INTEGRATION WITH SECURITY DETECTION SYSTEMS - ACCESS CONTROL SYSTEMS:

Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Provide the display of access control status on the BMS operator client.
Provide on the BMS operator workstation building graphics/schematics indicating the location of access control devices along with their respective status.
Ensure that an alarm condition or an access control system can automatically display the appropriate building graphic/schematic along with the relevant sensor/detector status.
Ensure that no configuration of access cards is possible via the BMS.
Ensure that building services control actions operate correctly in response to the status of the access

control system.

320.310 INTEGRATION WITH LIGHTING CONTROL SYSTEMS:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Ensure that the following functionality is provided:

- Switching of lighting zones in accordance with zone occupation times as set on the BMS.
- Switching of lighting zones in accordance with occupancy sensing and light level sensing where this is provided by the BMS.
- Monitoring of lighting zones.
- Monitoring of lamp run hours.
- Raising of an alarm on lamp run hours exceeding the specified maximum.
- The ability to override zones.

Ensure that re-definition of zones cannot be performed via the BMS.
Direct interoperability – Ensure that the requirements of clause 310.470 are met.
Gateway link - Ensure that the requirements of clause 310.480 are met.

330.330 CONTROLS CIRCUITS:
Supply Voltage - Ensure control circuits are DC (negative-earth) or AC 230 V sourced from common single-phase supply. Control circuits from single-phase supplies derived from different phases shall not be used in the same enclosure.

330.340 CONTROL CIRCUITS TRANSFORMERS:
Provide control circuit transformers to supply power at voltages to suit control components.
Standards
Use transformers in accordance with BS EN IEC 61558-1 and either BS EN 61558-2-2 or BS EN 61558-2-6, and provide an external label of approved type and size.
Protection - Primary and secondary fuses

340.000 WORKMANSHIP:

340.010 GENERAL:
Install pipeline control components in accordance with manufacturer's instructions.
Install ductline control components in accordance with DW/144 and manufacturer's instructions.
Install control components in accordance with manufacturer's recommendations, in positions indicated.

340.020 APPEARANCE:
Arrange, support and clip all control wiring, pneumatic tubes and capillaries to present a neat appearance, with other services and the building structure.

340.030 INSULATION:
Where control components are incorporated in insulated pipelines, ductlines or equipment, provide details for approval of method proposed to insulate component.

340.040 SUPPORTS:
Arrange supports for control components to ensure no strain is imposed on components.

340.050 ACCESS:
Arrange control components to ensure adequate access for operation and maintenance.
Comply as relevant with BS EN 547-series and BS 7671 (IET Wiring Regulations) requirements for maintenance gangways.

340.080 POWER OPERATED CONTROLS:
Install power operated controls in accordance with manufacturer's instructions and relevant standards.

340.090 ELECTRIC MOTOR ACTUATORS:
Securely mount actuators to rigid members, free from vibration or distortion in accordance with manufacturer's recommendations. Select mounting positions to require minimum linkages, and to avoid angular drive to operating levers. Allow access for servicing and replacement.

340.100 SENSORS/CONTROLLERS:
Install sensors/controllers in accordance with manufacturer's instructions, in accessible locations. Install wall mounted components, where indicated.

340.105 TEMPERATURE SENSOR LOCATION:
Internal

Install temperature sensors: out of sources of draughts; away from doors and sources of heat or cooling; away from sources of water / sinks; out of the reach of direct sunlight; not in partitioned offices; approximately 1500 mm above floor; in a position which will not be covered.
They should also be coordinated with the Architect's furniture drawings to ensure they are not blocked or covered.
The Contractor shall ensure that the conduit to the back of the sensor is completely sealed.

External

Out of the reach of direct sunlight; away from any heat sources, exhaust, open windows; in a safe, tamperproof location.

340.110 ANCILLARIES:
Install ancillaries in accordance with manufacturer's instructions.

340.120 ENCLOSURES:
Install enclosures where indicated, providing space for access and maintenance.

340.121 PACKAGED PLANT:
Make all digital and analogue control interfaces between the BMS and packaged plant as detailed on the Controls diagrams and individual plant schedules and elsewhere in the specification.
Make connections to packaged plant within the plant control panel. Where insufficient space within such panels fit a further enclosure to the plant to accommodate the connections.

340.122 PANELS, WIRING AND WIRE WAYS:
Install all Panels, wiring and wire ways as described in the appropriate reference specifications.

Other than in individual starters and the interlocks from local isolators, the control circuit voltage shall not exceed 110 Volts ac (55-0-55). Where control circuits are taken outside the enclosure to remote equipment use 24 Volts maximum.
Where modifying existing installations, agree the detail of the above with the S.O.

340.130 BUILDING MANAGEMENT SYSTEM INSTALLATION:
Install commission and set to work building management system in accordance with the manufacturer's recommendations.

340.140 BUILDING MANAGEMENT SYSTEM CABLE INSTALLATION:
Plan and install all building management monitoring systems cables in accordance with the cable manufacturer's recommendations.
Label and record all monitoring cables

340.150 BUILDING MANAGEMENT SYSTEM QUALITY CONTROL:
Handle, store and install equipment and components of the building management system in accordance with the manufacturer's recommendations.
Inspect all equipment and components on delivery, before fixing and after installation and reject and replace any which are defective.
Record all commissioning tests and site modifications to hardware or software, and revise operating and maintenance instructions accordingly.
Inspect installed and operational functions of Building Automation, Controls and Technical Building Management System including its configuration in accordance with BS EN 16946-1.
Manage configuration of software, settings, data and design, in accordance with an appropriate Configuration Management Plan complying as necessary with BS EN ISO 9001, BS ISO 10007, BS ISO/IEC 12207 and BS ISO/IEC/IEEE 15288.
Provide configuration details along with the operation and maintenance manual on handover.
Manage information security systems, software and data during design, implementation and

commissioning in line with BS EN ISO/IEC 27001.

340.160 CONTROL SYSTEM FUNCTION CHARTS:
Prepare function charts for the control system in accordance with BS EN 60848. Obtain approval for function chart before design of system hardware or writing control software.

350.000 COMMISSIONING:
Commission in accordance with CIBSE Commissioning Code C. Refer to section Y51 for BMS commissioning and seasonal commissioning requirements.
Undertake and manage integrated commissioning in accordance with CIBSE Commissioning Code M: Commissioning Management
- Perform interface testing with all other logically-connected systems
- Perform whole building integrated testing as scheduled or described in the scope of works.
- Perform black building integrated testing as scheduled or described in the scope of works.

The BMS / controls specialist shall assist with seasonal commissioning during four separate occasions with three monthly intervals during the defects liability period in the first year after handover unless scheduled or detailed otherwise elsewhere in this specification.

360.001 DEMONSTRATION AND HANDOVER:
Refer to General scope of works for project particular requirements and section Y51 and “A” sections of the specification for standard clauses for BMS witnessing requirements, operator training and post-handover checks.
Refer to work section A37 or A64 or A64D for requirements for BMS O&M manual.

360.040 SOFTWARE:
Ensure that a copy of the configuration software is securely held both on and off-site.
Ensure that, as alterations are made to the configuration software, all previous versions of the software are securely archived.
Ensure that all credentials are transitioned to the operation and maintenance organisation(s) at handover.

10000 Ref NES Text Dec 19

1010 PRE-FABRICATED PIPEWORK:

Supply pre-fabricated pipework in accordance with relevant materials and workmanship clauses and as detailed in the particular specification / schedules. When using proprietary piping systems / ancillaries, comply with the manufacturers' installation instructions.

1012 PIPEWORK LAYOUT / GENERAL REQUIREMENTS / FIRE STOPPING:

[Partly based on NES 210.010 210.050]

General

Set out pipework as indicated on the installation drawings, making due allowance for any diagrammatic presentation.

The tender drawings show the design intent and do not necessarily show all facilities for filling, flushing, cleaning, draining and chemical cleaning of the water systems.

The Contractor shall include in the installation all necessary facilities, including sample coolers (if required), to enable a Specialist to successfully fill, drain, flush, clean, and chemically treat the systems listed in schedule Y25 in accordance with the latest edition of BSRIA Guide BG29 “Pre-commissioning cleaning of pipework systems”.

The Contractor shall review all designs to ensure that systems are commissionable in accordance with the CIBSE commissioning code W and BSRIA Guide BG2/2010 as detailed in Y51. If additional facilities are required the Contractor shall advise the designer prior to commencing work on site.

All pressure equipment shall be designed, manufactured and certified in accordance with the Pressure Equipment Regulations 1999 and The Approved code of practice (ACOP) L 122 “Safety of Pressure Systems

Provide all necessary offsets, bends, tapers, transformation pieces, anchors and guides etc. required whether or not these are detailed.

Make due allowance for any thermal movement on long runs. Any provisions for expansion, anchors and guides shown on the drawings are for guidance, the actual requirements shall be determined by the Contractor. Also refer to clause Y10.4061 and clauses Y11.2611, 2620, 2631/2631A/2631B, 2651and 2661 for further detail on expansion facilities. The contractor shall utilise one of the named specialists for the provision of expansion facilities and confirm in their tender submission that all provisions for pipework expansion have been included.

Multilayer pipe system for indoor gas installations manufactured and installed as a complete system from a single manufacturer including pipes, fittings, tools etc. in accordance with BS ISO 17484-1 and ISO 17484-2

Multilayer pipe systems for indoor hot and cold water installations and heating systems manufactured and installed as a complete system from a single manufacturer including pipes, fittings, tools, etc. in accordance with relevant parts of BS EN ISO 21003

Plastics piping systems for hot and cold water systems or hot water heating systems within buildings to have a classification appropriate to the application / service conditions and have a design period of 50 years in accordance with BS ISO 10508.

The plastic piping system manufacturer to demonstrate the system has been tested in accordance with BS EN ISO 19893 for the resistance of assemblies of pipes and fittings to temperature cycling.

Fire stopping

Comply with BS 9999, relevant approved technical guidance to Building Regulations and BESA Technical Bulletin TB/032

Install and inspect fire stopping systems in accordance ASFP Code of Practice TDG17. Use proprietary systems, tested and assessed to BS EN 1366-3 and BS EN 1366-4 and classified to BS EN 13501-2.

All products used, to have third party product certification by a scheme accredited by UKAS.

Only use UKAS accredited, third party installer certified specialist contractors. The specialists should be ASFP members and their certification must cover the passive fire protection element they are installing.

Install all fire stopping systems in accordance with the manufacturer's written instructions and the test/assessment/certification evidence provided by the installer / manufacturer of the penetration seal.
Support centres for services passing through penetration seals serving fire barriers to be the same as those covered by the test/assessment/certification evidence provided by the installer / manufacturer of the penetration seal.
Unless detailed otherwise pipe closers for plastic pipes to be stainless steel collar with fixing brackets with intumescent liner. Installation to be in accordance with the manufacturer's instructions and grouted/sealed using the manufacturer's proprietary compound/sealant.
Standards - Test to BS EN 1366-3 and BS EN 1363-1.

Fire resistance to match resistance of wall or floor.

1020 FITTINGS:
For changes in direction use centreline radius/nominal bore of not less than 1.5 unless otherwise directed. For reductions and enlargements use easy transition type with inclined angle not exceeding 30 degrees.
All fittings, pipe joints and flanges PN rating shall be suitable for hydraulic test pressure of the system (ie minimum of 1.5 times the maximum operating pressure).

1030 FABRICATED FITTINGS:
Use only with approval, if manufacturer's standard fittings are not available.

1041 PIPE JOINTS:
Obtain approval from Local Water Authority or Water Research Centre for materials used in water supplies. Ensure pipe joints do not occur within elements of the building (walls, floors, partitions etc).
All pipe joints and flanges shall be suitable for hydraulic test pressure of the system.

1100 PIPEWORK, FITTINGS AND VALVES FOR GAS
N/A

1105 JOINTING OF GAS PIPEWORK
N/A

2000 PRODUCTS/MATERIALS PIPELINES
N/A

2010A WELDED OR SEAMLESS STEEL TUBE TO BS EN 10255:
N/A

2010D GALVANIZED STEEL PIPES TO BS EN 10255:
N/A

2012A LIGHT GAUGE CARBON STEEL FOR PUSH-FIT AND PRESS-FIT SYSTEMS:
N/A

2031 SEAMLESS CARBON STEEL TUBE TO BS EN 10216 -1 or BS EN 10216-2
N/A

2050 WELDED STEEL TUBES TO BS EN 10217-1:
N/A

2055 WELDED STEEL TUBES TO BS EN 10217-2:
N/A

2061 CARBON STEEL FITTINGS, BUTT WELDED TO BS EN 10253:
N/A

2070 MALLEABLE CAST IRON FITTINGS, SCREWED:
N/A

2081 DUCTILE CAST IRON and STEEL FITTINGS, GROOVED FOR MECHANICAL JOINTS:
N/A

2091 WROUGHT STEEL FITTINGS, SCREWED TO BS EN 10241
N/A

2101 WROUGHT CARBON AND FERRITIC ALLOY STEEL FITTINGS TO BS 1640 PART 3:
N/A

2220 LIGHT GAUGE STAINLESS STEEL TO BS EN 10312 FOR WATER APPLICATIONS:
N/A

2221 LIGHT GAUGE STAINLESS STEEL - MANUFACTURER'S STANDARD:
N/A

2250A AUSTENITIC STAINLESS STEEL (SEAMLESS TUBE):
N/A

2250B AUSTENITIC STAINLESS STEEL (WELDED TUBE):
N/A

2255A STAINLESS STEEL FITTINGS, GROOVED MECHANICAL JOINTS:
N/A

2257 STAINLESS STEEL PUSH-FIT FITTINGS
N/A

jointing systems

2258 CARBON STEEL PUSH-FIT FITTINGS:
N/A

2260A COPPER, ANNEALED (SOFT):
Material - Copper.
Standard - BS EN 1057, R220 coiled tube.
Dimensions - BS EN 1057 table 3.
Ends - Plain.
Finish - Uncoated.

2271 COPPER, HALF HARD:
Material - Copper
Standard BS EN 1057, R250
Dimensions -as BS EN 1057 table 3
Ends – Plain or grooved for mechanical joints
Finish - Uncoated or Chromium plated as scheduled.

2272 POLYETHYLENE SHEATHED COPPER (HALF HARD OR SOFT):

Material - Copper.
Standard - BS EN 13349 and BS EN 1057, R220 or R250 as scheduled.
Dimensions - BS EN 1057 table 3.
Ends - Plain
Finish - Sheathed in polyethylene (colour to suit application) or Sheathed in profiled white polyethylene (air channels on the internal surface) as scheduled.

2290A COPPER, HARD:

Material - Copper.
Standard - BS EN 1057, R290.
Dimensions - BS EN 1057 table 3.
Ends - Plain.
Finish - Uncoated.

2292 COPPER TUBE FOR REFRIGERATION:

Material - seamless copper.
Standards
BS EN 12735-1 for tubes for air conditioning and refrigeration piping systems
BS EN 12735-2 for tubes for equipment
Ends - Plain.
Finish - Uncoated.

2294 COPPER TUBE FOR MEDICAL GASES / VACUUM INSTALLATIONS:

Material - degreased copper
Standards - BS EN 13348 and HTM 02
Ends - Plain.
Finish - Uncoated.

2311 CAPILLARY FITTINGS FOR COPPER TUBING GENERAL POTABLE RANGE

Material	: Copper or Copper alloy (non-dezincifiable).
Standard	: BS EN 1254-1.
Size range	: 6mm to 67mm
Dimensions	: BS EN 1254-1.
Ends	: Socket - pre-soldered or plain.
Finish	: Natural cast.

2316 PRESS FITTINGS FOR COPPER TUBING:

Material
Copper or dezincifiable resistant copper alloy or gunmetal
Gunmetal.
Standard - Manufacturer's standard, electrically continuous.
Size range - 15mm to 108mm.
Dimensions - to suit copper tube to BS EN 1057.
Ends - with EPDM or Butyl rubber O ring for use with water, Acrylonitrile butadiene rubber for use with natural gas
Finish - Natural.

2321 COMPRESSION FITTINGS FOR COPPER TUBING

Material	: Copper or Copper alloy (dezincification resistant).
Standard	: BS EN 1254 -2 Type A non manipulative
Size range	: 6mm to 67mm
Dimensions	: BS EN 1254-2.
Ends	: Socket
Finish	: Natural

2322 SOLDER

N/A

2325 PUSH-FIT FITTINGS FOR COPPER TUBING:
Material – Dezincification resistant copper alloy and brass.
Standard - Manufacturer's standard, electrically continuous.
Size range - 15mm to 54mm.
Dimensions - to suit copper tube to BS EN 1057.
Ends - push-fit with EPDM O ring.
Finish - Natural.

2351 CAST IRON PIPES AND FITTINGS TO BS 416 PART 1:
N/A

2391 GREY CAST IRON PIPES AND FITTINGS TO BS EN 877:
N/A

2431 LAYERED PIPE AND FITTINGS FOR HOT AND COLD WATER HEATING AND CHILLED WATER:

Multi-layer pipe systems for indoor hot and cold water installations and heating systems manufactured and installed as a complete system from a single manufacturer including pipes, fittings, tools, etc.

Design Parameters

The pipe shall have a continuous temperature rating of 95^0C (and be capable of withstanding short durations at temperatures of up to 110^0C.)
The pipe shall have a maximum working pressure rating of 10 Bar and useful life expectancy of 50 years.

Standards

Manufactured to relevant parts of BS EN ISO 21003 to under a certified quality assurance scheme which meets the BS EN ISO 9001 standard. The pipe and fittings shall be tested and approved by WRAS and carry a current WRAS certificate.

Materials

As scheduled or described in the scope of work for each system.

Pipe Construction

The pipe shall have details of manufacturer, materials, maximum pressure and maximum temperature printed \on the outer wall.
The multilayer pipe shall be a composite pipe comprising a continuous aluminium oxygen barrier sandwiched between an inner and outer layer of cross linked polyethylene PE-X.
The aluminium oxygen barrier shall be a minimum of 0.4mm thick and continuously butt welded.

Jointing / workmanship

DZR brass compression, DZR brass press fit or PVDF press fit jointing systems. The jointing systems shall have the same design parameters as the pipe.

The cutting and jointing of the pipe shall be undertaken using only those tools recommended by the manufacturer.

All pipes shall be calibrated and chamfered using the appropriate tool prior to joining.
Brass or metal fittings shall incorporate a captive Teflon seating ring to prevent electrolytic action between the oxygen barrier and fitting.
The outer shroud of any press fittings shall have an inspection hole which shall allow the installer to determine whether the pipe has been pushed fully into the fitting.
The leading edge of any inserts shall be tapered to reduce the risk of debris building up at the fitting.

Final connections to sanitary ware, appliances or equipment shall be achieved using WRAS approved flexible connections with integral servicing valves.
For all sizes up to 32mm long radius bends shall be formed by hand. Short Radius bends shall be formed using a bending spring or proprietary bending machine. For details contact manufacturer.
Multilayer Pipes shall be cut with a guillotine or ratchet type blade cutter of a design approved by the manufacturer.

Support spacing

Multilayer pipe shall be fixed in accordance with the maximum spacing details as follows:-

Pipe Size	Maximum Spacing
14 x 2mm pipe	1.0m
16 x 2mm pipe	1.0m
18 x 2mm pipe	1.25m
20 x 2mm pipe	1.25m
26 x 3mm pipe	1.5m
32 x 3mm pipe	2.0m
40 x 3.5mm pipe	2.0m
50 x 4mm pipe	2.0m
63 x 4.5mm pipe	2.0m

Where a branch or bend is installed brackets shall be installed within 300mm of the fitting.

2440 MULTILAYERED PLASTICS PIPE SYSTEMS FOR INDOOR GAS INSTALLATIONS TO BS ISO 17484-1:
Material - Stress bearing polymeric materials, with or without a metallic layer.
Size range - 16mm to 63mm.
Dimension - Manufacturer's standard.
Fittings - Mechanical, electrofusion.
Finish - Manufacturer's standard.

2442 PLASTIC PIPING SYSTEMS TO BS EN 15014:
Standard - BS EN 15014.
Application - Buried and above ground systems for water (not potable) and other fluids under pressure.
Performance characteristics for pipes, fittings and their joints.
Performance characteristics - reaction to fire; external pressure strength; internal pressure strength; dimensional tolerance; tightness (air and water); durability; dangerous substances.

2455 PLASTICS PIPING SYSTEMS FOR WATER SUPPLY – PIPES TO BS EN 1452:
Material - Unplasticised polyvinyl chloride (PVC-U).
Standard - BS EN 1452-2.
Dimensions
Length - manufacturer’s standard range.
BS EN 1452-2 tables 1, 2, 3, 4 and 5.
Ends
Plain or socket and spigot for solvent cement.
Finish
Blue or grey.

2475 PLASTICS PIPING SYSTEMS FOR WATER SUPPLY –FITTINGS TO BS EN 1452:
Material - Unplasticised polyvinyl chloride (PVC-U).
Standard - BS EN 1452-3.
Size range - 12mm 315mm
Dimensions
Length - manufacturer’s standard range.
BS EN 1452-2 tables 1, 2, 3, 4 and 5.
Ends
Plain.
Socket and spigot for solvent cement.

Finish - Grey..

2480 UNPLASTICIZED PVC TO BS 4514:
Material - Unplasticized PVC.
Standard - BS 4514.
Dimensions - BS 4514.
Ends
Plain.
Socket to BS 4514, solvent cement.
Finish
Grey.

2490 UNPLASTICIZED PVC FITTINGS, SOLVENT WELDING TO BS 4514:
Material - Unplasticized PVC.
Standard - BS 4514, table 2.
Size range - 82mm, 110mm or 160mm.
Dimensions - BS 4514, tables 3 and 5.
Ends - Spigot/plain.
Finish - grey

2495 PLASTICS PIPING SYSTEMS TO BS EN 1453-1:
Plastics piping system with structured-wall pipes for soil and waste discharge (low and high temperature) within building structure.
Material - Unplasticised polyvinyl chloride (PVC-U).
Standard - BS EN 1453-1.
Dimensions
Length - manufacturer's standard range.
BS EN 1453-1 tables 1, 2 and 3.
Ends – Plain or elastomeric ring seal socket and spigot or socket and spigot for solvent cement.
Finish - Grey or white as indicated.

2521 POLYETHYLENE TO GAS INDUSTRY STANDARD GIS/PL2 -2:
N/A

.

2528 POLYETHYLENE PIPES FOR GASEOUS FUELS TO BS EN 1555:
N/A

2531

POLYETHYLENE FITTINGS, FUSION TO GIS/PL2 PART 2:

Material	: Polyethylene.
Standard	: To GIS/PL2 Part 2.
Size range	: Socket type up to 125mm.
	: Butt type up to 500mm.
	: Saddle type up to 180mm.
Dimensions	: To GIS/PL2 Part 2.
Ends	: Plain.
Finish	: Natural self-colour.

2538 POLYETHYLENE FUSION FITTINGS TO BS EN 1555:
Material - Polyethylene.
Standard - BS EN 1555-1, BS EN 1555-3 and BS EN 1555-5.
Dimensions - BS EN 1555-3, Section 6, to suit pipes to BS EN 1555-2.
Marking - BS EN 1555-3, table 7.
Ends - Sockets with heating elements for fusion jointing.
Finish
Yellow.

2545 PLASTICS PIPING SYSTEMS BS EN 1451 - PIPES:
Plastics piping system for soil and waste discharge (low and high temperature) within building structure.)

Material - Polypropylene (PP).
Standard - BS EN 1451-1 and BS EN 15012.
Dimensions
Length - manufacturer's standard range.
BS EN 1451 tables 1, 2, 3 and 4.
Ends
Socket and spigot for solvent cement.
Finish
Black.

2553 PLASTICS PIPING SYSTEMS FOR NON-PRESSURE UNDERGROUND DRAINAGE AND SEWERAGE - STRUCTURED WALL PIPING SYSTEMS OF PVC-U, PP AND PE:
Standards – BS EN 13476-1 and BS EN 13476-2 or BS EN 13476-3
Material
Poly vinyl chloride (PVC-U).
Polypropylene (PP).
Polyethylene (PE).
Type A - Pipes and fittings with smooth internal and external surface.
Type B - Pipes and fittings with smooth internal and profiled external surface.

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2555 PLASTICS PIPING SYSTEMS TO BS EN 1451 - FITTINGS:
Plastics piping system for soil and waste discharge (low and high temperature) within building structure.)
Material - Polypropylene (PP).
Standard - BS EN 1451-1 and BS EN 15012
Size range - 32mm to 315mm.
Dimensions - BS EN 1451 tables 5 - 8.
Ends
Plain.
Elastomeric ring seal socket and spigot.
Socket and spigot for solvent cement.
Finish
Black.

2580A SOLID WALL PVC-U PIPING SYSTEMS – PIPES / FITTINGS:
Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure.
Material - Unplasticised polyvinyl chloride (PVC-U).
Standard - PVC-U to BS EN 1329-1 and BS 4514 as appropriate to the application.
Size range - 32mm to 315mm.
Dimensions - Length - manufacturer's standard range. BS EN 1329-1 tables 1-4 & 5-14
Ends - Plain; elastomeric ring seal socket and spigot; or socket and spigot for solvent cement.
Finish - Grey, black, or white.

2580B SOLID WALL PVC-U PIPING SYSTEMS – PIPES / FITTINGS (with upto 65% recycled PVC):
N/A

2580C PE PIPING SYSTEMS - PIPES:
Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure.
Material - Polyethylene (PE).
Standard - PE to BS EN 1519-1.
Dimensions - Length - manufacturer's standard range.BS EN 1519-1 tables 2-5 & 6-10.
Ends - Plain; elastomeric ring seal socket and spigot; or socket and spigot for solvent cement.
Finish - Grey, black, or white.

2580F STRUCTURED-WALL PVC-U PIPING SYSTEMS - PIPES:
Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure.
Material - Unplasticised polyvinyl chloride (PVC-U).
Standard – Structure-wall PVC-U to BS EN 1453-1

Dimensions - manufacturer's standard range. BS EN 1453-1.
Ends - Plain; elastomeric ring seal socket and spigot; or socket and spigot for solvent cement.
Finish - Grey.

2595 PLASTICS PIPING SYSTEMS TO BS EN ISO 15874:
Plastics piping systems for hot and cold water installations, including heating, within buildings.
Material - Polypropylene (PP).
Standards
BS EN ISO 15874-1 - General
BS EN ISO 15874-2 - Pipes
BS EN ISO 15784-3 - Fittings
BS EN ISO 15784-5 - Fitness for purpose of system
Dimensions - manufacturer's standard range.
Pipe ends - Plain, socket for fusion fittings, socket for electrofusion fittings, for mechanical fittings or fittings with incorporated inserts.
Fittings ends - Plain, socket fusion fittings, electrofusion fittings, mechanical fittings or fittings with incorporated fittings

2597 PLASTICS PIPING SYSTEMS TO BS EN ISO 15875:
Plastics piping systems for hot and cold water installations, including heating, within buildings.
Material - Crosslinked polyethylene (PE-X).
Standards
BS EN ISO 15875-1 - General
BS EN ISO 15875-2 - Pipes
BS EN ISO 15875-3 - Fittings
BS EN ISO 15875-5 - Fitness for purpose of the system
Dimensions - manufacturer's standard range.
Ends - Plain, suitable for electrofusion fittings, mechanical fittings, or fittings with incorporated inserts.
Fitting ends - Plain, socket fusion fittings, electrofusion fittings, mechanical fittings or fittings with incorporated fittings

2599 PLASTICS PIPING SYSTEMS TO BS EN ISO 15876:
Plastics piping systems for hot and cold water systems, including heating, within buildings.
Material - polybutylene (PB).
Standards:
BS EN ISO 15876-1 - General
BS EN ISO 15876-2 - Pipes
BS EN ISO 15786-3 - Fittings
BS EN ISO 15876-5 - Fitness for purpose of the system
Dimensions - manufacturer's standard range.
Ends - Plain, sockets for fusion fittings, suitable for electrofusion fittings, mechanical fittings, or fittings with incorporated inserts.
Fittings ends - Plain, socket fusion fittings, electrofusion fittings, mechanical fittings or fittings with incorporated fittings.
Finish - Natural or coloured.

2601 PLASTICS PIPING SYSTEMS TO BS EN ISO 15877:
Plastics piping systems for hot and cold water installations within buildings.
Material - chlorinated poly(vinyl chloride) (PVC-C).
Standards
BS EN ISO 15877-1 - General
BS EN ISO 15877-2 - Pipes
BS EN ISO 15877-3 - Fittings
BS EN ISO 15877-5 - Fitness for purpose of the system
Dimensions - manufacturer's standard range.
Pipe ends - Plain, single socket.
Fittings ends - Plain, cylindrical sockets or conical sockets.

2603 PLASTICS PIPING SYSTEMS TO BS EN ISO 22391:
Plastics piping systems for hot and cold water installations within buildings.
Material - Polyethylene of raised temperature resistance (PE-RT).
Standards

BS EN ISO 22391-1 - General
BS EN ISO 22391-2 - Pipes
BS EN ISO 22391-3 - Fittings
BS EN ISO 22391-5 - Fitness for purpose of the system
Dimensions - Length and wall thickness - manufacturer's standard range.
Pipe ends - Plain, single socket.
Fittings ends - Plain, cylindrical sockets or conical sockets

2630 ABS TO BS 5391 PART 1:
Material - ABS (Acrylonitrile-butadiene-styrene).
Standard
BS 5391 Part 1, class B ,C,D, or E to match system working pressure.
Dimensions
BS 5391 Part 1, table 1 - lengths 3m, 6m and 9m.
Ends
Plain.
Finish - Natural.

2640 ABS FITTINGS, SOLVENT WELDING TO BS 5392 PART 1:
Material - ABS (Acrylonitrile-butadiene-styrene).
Standard
BS 5392 Part 1, class B,C,D,or E to match system working pressure
Size range - 10mm to 200mm.
Dimensions - BS 5392 Part 1, table 1.
Ends - Spigot/socket.
Finish - Natural.

2665A POLYETHYLENE TO WIS 4-32-17:
Material - Polyethylene.
Standard - WIS 4-32-17.
Dimensions - WIS 4-32-17 table 6.
Lengths - straight pipe 6m, 12m or 18m; coils, 25m, 50m, 100m or 150m.
Ends - Plain.

2668 POLYETHYLENE PIPES TO BS EN 12201:
Material - Polyethylene.
Standard - BS EN 12201-1, BS EN 12201-2, BS EN 12201-5
Dimensions
BS EN 12201-2, table 1
Lengths
Straight pipe 6m, 9m or 12m.
Coils 50m, 100m or 150m.
Manufacturer's standard.
Marking
BS EN 12201-2, table 6
Ends
Plain.
Finish
Blue.

2669 POLYETHYLENE FITTINGS TO BS EN 12201:
Material - Polyethylene.
Standard - BS EN 12201-3.
Type
Electrofusion.
Dimensions
BS EN 12201-3, section 6 and Annex A.
Marking
BS EN 12201-3, table 7.
Ends - Plain.
Finish
Blue.

2705A PLASTICS PIPES / FITTINGS TO BS 7291:
Thermoplastics pipe and fitting systems for hot and cold water for domestic purposes and heating installations in buildings
General requirements - BS 7291-1
Material - Polybutylene (PB) BS 7291-2; or crosslinked polyethylene (PE-X) BS 7291-3.
Standard - BS 7291.Classification H unless otherwise indicated.
Dimensions - BS 7291-2 (PB) or BS 7291-3 (PE-X); Table 1 (CU) or Table 2 in accordance with BS ISO 11922-1, BS ISO 4065 or to BS ISO 161-1.
Ends - Plain.flanged or screwed to suit method of jointing
Finish - Natural.

2707 PUSH-FIT FITTINGS FOR PE-X AND PB TUBING:
Material - Dezincifiable resistant copper, copper alloy and brass.
Standard - Manufacturer's standard.
Size range - 10mm to 28mm.
Dimensions - to suit PE-x and PB tube.
Ends - push-fit.
Finish - Natural.

2710 VULCATHENE:
Material
Polypropylene suitable for laboratory drainage.
Standard - To manufacturer's standard (No BS available).
Dimensions
Nominal diameter 38mm to 152mm available, standard length 4m.
Ends - Plain.
Finish - Black.
Joints
Electro fusion welded

2720 VULCATHENE FITTINGS:
Material
Polypropylene.
Standard - To manufacturer's standard (No BS available).
Size range - Nominal diameter 38mm to 152mm.
Dimensions - Nominal diameter 38mm to 152mm available.
Ends
Socket for heat fusion jointing.
Finish - Black.

2731 PLASTIC PIPING SYSTEMS FOR INDUSTRIAL APPLICATIONS:
Material – As scheduled.
Standards
BS EN ISO 15493 for ABS, PVC-U or PVC-C
BS EN ISO 15494 for PB, PE, PE-RT, PE-X or PP

2741 GLASS PIPELINE
Material : Borosilicate glass 3.3.
Standard : BS EN 1595.
Dimensions : BS EN 12585
Ends : Spherical or flat buttress.
Finish : Natural self finish.

2742 STAINLESS STEEL PLIABLECORRUGATED TUBING KIT FOR GAS UP TO 0.5 BAR:
N/A

2881 PRE- INSULATED UNDERGROUND BONDED PIPE SYSTEMS - STEEL
N/A

2882 PRE-INSULATED FLEXIBLE INSULATED UNDERGROUND PIPELINES – METAL

N/A

3012 CIRCULAR FLANGES FOR PIPES AND FITTINGS:

Material : Ferritic steel, BS EN 1092-1
Cast iron, BS EN 1092-2
Aluminium alloy BS EN 1092-4

Flange type : Hubbed slip-on flange for welding.

Associated bolts, nuts and washers:

For ferrous and composite flanges
: Interior use - Black mild steel
: Exterior use - Cadmium plated to BS 7371-12

For copper alloy flanges use high tensile brass.

Bolts to be of suitable length so as to show no more than three threads past the nut

Flange facings : Raised face.

3021 FLANGE JOINTING RINGS:

Non metallic flat gaskets for flanges to BS EN 1092-1, or BS EN 1092-2 or BS EN 1092-3 or BS EN 1092-4

Standard – relevant parts of BS EN 1514

Full face.

Supply joint rings manufactured from:-

Asbestos free compressed synthetic fibre with suitable binder for the operating conditions.

3031 SCREWED JOINT TO BS EN 10226:

Use PTFE tape to BS 7786 or use hemp and jointing compound to BS 6956 Part 5 or BS EN 751-2 6956 Part 6, prior to chemical treatment and use PTFE tape to BS 7786 after chemical treatment.

3041 UNION CONNECTIONS:

Seating:

Spherical seating:- bronze to bronze, navy pattern.

3051 WELDED JOINTS:

N/A

3061 BRAZED JOINTS:

Use filler metals to BS ISO 17672

For zinc free brazed joints use nickel bearing zinc free grades of filler metals to BS ISO 17672

3071 CAPILLARY JOINTS:

N/A

3080 JOINTING EQUIPMENT FOR MULTI-LAYER PIPE SYSTEM:

Provide the Manufacturer's recommended compression tool for making connections in the multi-layer pipe system.

3091 FLEXIBLE JOINTS, CAST IRON PIPES:

N/A

3095A JOINTING MATERIALS FOR PLASTICS PIPES TO BS 7291:

Plastics fittings to BS 7291.

Method of jointing to BS 5955 Part 8

Compression with fittings to BS EN 1254-3

3102 JOINTING EQUIPMENT FOR PUSH-FIT SYSTEM:
Provide manufacturer's recommended tool for releasing push-fit fittings in push-fit jointing systems for copper and plastic pipe.

3125 JOINTING EQUIPMENT FOR PRESS FITTING SYSTEM:
Provide the manufacturer's recommended press fitting tools including pressing tool, de-burring tool and insertion depth marker for use with press fitting system, these must be used for all joints.

3131 PRESS FITTING JOINTING SYSTEM ON STAINLESS STEEL PIPE:
Material
Stainless Steel.
Standard
To BS EN 10216 / 10217 or BS EN 10312.
Size range
15mm to 108mm for water.
15mm to 108mm for gas.
Dimensions - to suit stainless steel pipe to BS 10216/10217
Ends
With O ring seal for use with water or gas to suit application to manufacturer's standard.
Finish - Natural.

3132 PRESS FITTING JOINTING SYSTEM ON THIN WALL STEEL PIPE:
N/A

3135 PRESS FITTING JOINTING SYSTEM ON COPPER PIPE:
Material - Copper pipe.
Standard - To Manufacturers standard. Tube to BS EN 1057, fittings to BS EN 1254
Size range - 15mm to 108mm
Dimensions - to suit copper pipe to BS EN 1057.
Ends - with EPDM or Butyl rubber O ring for use with water, Acrylonitrile butadiene rubber for use with natural gas, all to manufacturer's standard.
Finish - To manufacturers standard
Comply with IGEM/UP/2 edition 3 Appendix 8 pressed fittings jointing procedure when used on natural gas pipework.

3141 MECHANICAL JOINTS, GROOVED STEEL PIPES:
N/A

3151 MECHANICAL JOINTS, GROOVED COPPER PIPES:
N/A

3190 WALL, FLOOR AND CEILING MASKING PLATES:

Materials	: Copper alloy, chromium plated.
Type	: Heavy, split on the diameter, close fitting to the outside wall of the pipe.
Fixing	: Chrome raised head fixing screws.

3200 PIPE RINGS AND CLIPS
Steel pipes
Use suitable pipe clips take into account the pipe load, material and pipe/insulation surface details.
Copper pipes
Use brass pipe clips

4000 WORKMANSHIP, GENERAL

4010 APPEARANCE:

Arrange all exposed pipe runs to present neat appearance, parallel with other pipe or service runs and building structure, subject to gradients for draining or venting.
Ensure all vertical pipes are plumb or follow building line.

4020 SPACING:

Space pipe runs in relation to one another, other services runs and building structure, allow for specified thickness of thermal insulation and ensure adequate space for access to pipe joints, etc.
The following are recommended as minimum clearances in spacing of pipe runs:-

Between	and	Clearance (mm)
Pipeline, insulated or uninsulated	wall finish	25
	ceiling finish or soffit	50
	floor finish	150
Insulated pipeline	adjacent service runs	25
uninsulated pipelines		50
adjacent pipelines	both uninsulated	150
	one uninsulated	75
	both insulated	25

4030 GRADIENTS:

Install pipework with gradients to allow drainage and/or air release,

4035 STEAM AND CONDENSE MAINS:

N/A

4041 AIR VENT REQUIREMENTS:

Air Vent Assembly to be either

An air bottle i.e.

A vertical extension from the pipe approximately 100mm long, at the bore of the pipe with a copper extension pipe with a manual vent cock located in an easily accessible position.

or

An automatic air vent valve with a copper outlet pipe from the valve to a tundish in an adjacent drain line or to another suitable location.

Provide vents at all high points. Vent to be manual unless otherwise indicated.

4050 DRAIN REQUIREMENTS:

Grade pipework to allow system to be drained. Provide a means of draining the system at all low points.
On all cooling coils in AHU's provide drain trap of at least twice working air pressure in depth.

Provide an air break between trap outlet and drainage system. Pipe each trap to drain via a tundish or pipe each trap separately to discharge over a gully to prevent the potential of cross contamination between AHU's.
In permanent bypasses in any heating, cooling or geothermal distribution systems where the dead leg is more than 3 times pipe diameter suitably sized drain valves should be incorporated to facilitate draining and cleaning.

4061 EXPANSION AND CONTRACTION:

Arrange supports and fixings to accommodate pipe movement caused by the thermal changes, generally allow the flexure at changes in direction. Allow for movement at branch connections. On drainage pipework use purpose designed fittings at changes of direction to accommodate movement, and to avoid stresses on connections to stacks.

Where possible provision for movement due to thermal expansion and contraction shall be made by natural changes in the direction of pipework.

Anchors and guides shall be positioned to contain all movement and resist the maximum loads imposed.

Anchors and guides are to be located at points which prevent excess stresses on pipework,

joints and equipment connections. Similar provisions shall be made for building movement or

building settlement.

For water systems, using a grooved pipework system, the proprietary flexible couplings may be used to accommodate thermal growth, contraction and for the elimination of expansion loops. The type, quantity required, locations and installation/support details of flexible couplings proposed shall be in accordance with the manufacturer's written recommendations and show on the installation drawings. Where loops are required, use flexible couplings on the loop.

Any provisions for expansion, anchors and guides shown on the drawings are for guidance, the actual requirements shall be determined by the Contractor.

The contractor shall utilize one of the named specialists and confirm in their tender submission that all provisions for pipework expansion have been included.

4065 CONNECTIONS BETWEEN PIPES OF DIFFERENT MATERIALS:

Plastic

Connect plastics pipework to pipework of other materials using approved connectors and methods in accordance with plastics pipework manufacturer's recommendations, to form a watertight joint.

Copper

Connect copper pipework to cast iron sockets using a caulking bush (brazed on), bitumenized yarn and an approved caulking compound neatly finished, to form a watertight joint, or connect copper pipework to cast iron using purpose made copper to iron connectors.

4071 PIPE FITTINGS:

Use eccentric type reductions and enlargements on horizontal pipe runs to allow draining and venting, concentric on vertical pipes, with easy transition and an included angle not exceeding 30 degree. Do not use bushes, except at radiators and at fittings where required size is not of standard manufacture. Where required, use eccentric bushes to allow draining or venting; maximum aspect ratio not to exceed two pipe sizes; above this ratio use reducing fittings. Use square tees at venting and draining points. Square elbows are not acceptable. Use bends and swept tees where practical, otherwise use elbows and square tees

4080 FABRICATED JUNCTIONS:

Form by inserting a branch section of a pulled bend into the main pipe. Develop the profiles of both the branch section and the hole in the main pipe, to ensure minimum protrusion into the main pipe. Weld or braze into position.

4090 FABRICATED FITTINGS - FERROUS:

Supply pipe material and end connections to the specification of the associated straight pipe runs.

Pattern

Bends, springs, offsets and branches.

Technique

Pipe bore 50mm or less - machine cold bend.

Pipe bore greater than 50mm - machine hot bend.

Ensure that fabricated branch bends of welding saddles are to the fitting proportions in BS EN 10253 –Parts 1 or 2 (depending on inspection requirements)

4105 ACOUSTIC INSULATION OF PIPEWORK

Material
Polymeric mass layer 10 kg/m^2
Standard -To manufacturer's standard.
Thickness -20mm to 100mm
Lengths -1m
Finish -Reinforced aluminium foil (outer)
Fire resistance to BS 476-6 and BS 476-7.
Installation -To manufacturer's standard.

4100 FABRICATED FITTINGS - NON-FERROUS:

Provide pipe material and end connections to the specification of the associated straight pipe runs.

Pattern

Bends, springs, offsets and branches.

Technique

Machine bend and ensure that machine guides and formers are smooth and clean, free from any scores, or other damage. Deformed bends will not be accepted.

Fabricate branch from a section of pulled bend, profiled to match the contour of the main to avoid overlap and protrusion into the main. Cut and swage the main to form a raised cup to accept the spigot end of the branch. Limit angle of the branch to 60o. Join by bronze welding on site. Apply reinforcement by plates, collars or shoes.

4110 PIPES THROUGH WALLS AND FLOORS:

Enclose pipes passing through building elements, (walls, floors, partitions, etc.) concentrically within purpose made sleeves. Fit masking plates where visible pipes pass through building elements, including false ceilings of occupied rooms.

Piped services (excluding gas pipes) that penetrate a floor separating habitable rooms in different flats within residential buildings shall be enclosed for their full height and full horizontal run in each flat and surrounded with sound absorbent material above and below the floor. The installation shall comply with the requirements of Approved Document E of the Building regulations. "Resistance to the passage of sound".

4120 PIPE SLEEVES THROUGH NON FIRE RATED PARTITIONS / FLOORS:

Where pipe insulation is not carried through pipe sleeve, cut sleeves from material same as pipe one or two sizes larger than the pipe to allow clearance. Do not use sleeves as pipe supports.

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.

Install sleeves flush with building finish. In areas where floors are washed down install with a 100mm protrusion above floor finish.

4125 PROPRIETARY PIPE SLEEVES THROUGH FIRE RATED PARTITIONS / FLOORS:

Where the insulation is to be carried through the partition - thermally insulated proprietary fire sleeves shall be used tested in accordance with the relevant parts of BS 476 or BS EN 1366-3 to meet the fire rating of the partition. The sleeves shall be either:

"Rockwool FirePro" Insulated fire sleeves comprising a combination of mineral wool and graphite intumescent or

"Pacifyer" one piece stainless steel sleeve with an intumescent lining the full length and 3 bands of acoustic foam adhered to the bore of the sleeve. Where the insulation is required to carry through the wall or partition / vapour seal is required oversized mineral wool shall be fitted to the pipework with an oversized Pacifyre fitted over the mineral wool

If ablative coated batt is used

All components and sealants / glue used must be tested to relevant parts of BS 476 or BS EN 1366-3 and BS ISO 5660-1, and be provided from a single manufacturer.

For plastic pipes, install a proprietary ablative coated batt in combination with a proprietary fire sleeve where the pipes pass through the batt. Ablative batt minimum density to be 180 kg/m3 and have a test certificate to match the fire resistance of the wall or partition and should have Loss Prevention Certification Board (LPCB) third party approval.

For metal pipes install proprietary fire rated insulation for 500mm either side of the batt. Standard - BS 3958-4

Installation – In accordance with the manufacturer's requirements.

4131 CONNECTIONS TO EQUIPMENT:

Make final connections to equipment in accordance with manufacturer's instructions and as indicated. Provide flanges or unions to enable removal of equipment with minimum disassembly of pipework.

4141 DISTRIBUTION HEADERS:

Terminate ends with a cap, a blank flange or as otherwise indicated.

4151 TEMPORARY PLUGS, CAPS AND FLANGES:

Seal all open ends as installation proceeds by plugs, caps or blank flanges, to prevent ingress of foreign matter.

Plug material

Metal.

or Plastic.

or Wooden.

In the event of such precautions not being taken, strip out pipework adjacent to open ends to demonstrate that fouling of bores has not occurred.

4160 FLANGED JOINTS GENERAL:

Use number and diameters of bolts to standard. Fit bolts of length to give not less than one thread, or more than 3mm protrusion beyond nut when joint is pulled up.

Fit washers under each nut.

4170 DISSIMILAR METALS:

Take appropriate means to prevent galvanic action where dissimilar metals are connected together. For grooved systems use proprietary dielectric waterway fittings with high temperature LTHS stabilised polyolefin liner.

4175 ELECTRICAL BONDING TERMINAL:

Provide site made electrical bonding connection of 6-mm^2 conductor, or purpose made fitting across all non-conducting joints in any pipework systems.

4180 PIPE RINGS AND CLIPS:

Select type according to the application and material compatibility, give particular attention where pipes are subject to axial movement due to expansion or contraction.

4191 ANCHORS:

Construct 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.

Steel Pipes

Construct using mild steel overstraps or heavy U-bolts. Secure to channel section, adequately attached to or grouted into building structure; weld longitudinal edges of strap to pipe.

or Pass two slip-on flanges over pipe to anchor point. Bolt together through an interposed mild steel channel section attached to or grouted into building structure, and finally weld flanges to pipe.

or Provide purpose designed anchors.

Copper Pipes

Fit two flanges to copper female adaptors in pipe run at anchor point. Bolt together through an interposed mild steel channel section attached to or grouted into building structure.

or Fit saddle clamps in pipe run at anchor point.

or Provide purpose designed anchors.

PVC Pipes

Clamp pipework to mild steel channel section attached to or grouted into building structure, using PVC coated overstraps, or clamps and with a polypropylene strip between pipe and mild steel section.

4201 SLIDE GUIDES:

Direct movement of expansion and contraction from pipe anchor points towards loops, bellows or flexible inserts. Ensure that thrust is linear relative to the axis of pipe.

Apply a friction reducing material between metal faces subjected to movement.

4207 PIPE SUPPORTS:

Arrange supports and accessories for equipment, appliances or ancillary fitments in pipe runs, so that no undue strain is imposed upon pipes.

Ensure that materials used for supports are compatible with pipeline materials. Unless otherwise indicated support DX pipes on galvanised cable tray suitably sized (both width and depth) for the pipes to be carried (to be able to support the pipes without sagging). Gusseted bends shall be used where required to match the radius of the pipe bends.

For grooved systems, pipework supports to fully comply with the manufacturer's instructions, submit calculations from the system manufacturer to demonstrate adequate allowance has been made for thermal expansion of the system.

Proprietary suspension systems to comprising channel sections with return sections with return lips and compatible fixing accessories made of material to BS EN 10162, BS EN 10210 and/or slotted angles to BS 4345.

Ensure support components for galvanised pipes have the same finishing method as the pipe carried out after manufacture.

Ensure all steel components such as studding, bolts and steel screws, bolts, nuts and washers are either cadmium plated and passivated or zinc electroplated to BS 7371 after manufacture. Do not use metal fixing components likely to deteriorate and/or cause damage through electrolytic action.

4210 SUPPORT SYSTEM - WIRE ROPE:

When proposed as an alternative support method to traditional drop rods, confirm wire rope is suitable for supporting pipelines.

4215 WIRE ROPE SUSPENSION SYSTEM:

Where used as an alternative to traditional drop rods.

Standards

- BS EN 12385-1.
- BS EN 13411-3.
- BS EN 13411-4.
- DIN 3093
- BSRIA COP 22/2002.

Material

- Stainless steel grade 316

Fastener

- Springs - stainless steel grade 302

Adjustment

- Tamperproof

Fixing

- Loop

Accessories

- Setting keys
- Span/bearer supports
- Ceiling clip fixings
- Threaded adaptors
- Anchor bolts

Anchor for stud fixings
Ceiling fixing kit
Corner saddle
Fastener décor cover

4220 SUPPORT SPACING:

Space supports as tables.

Pipe Size (mm)	Maximum Support Spacing (m)					
Nominal	Steel Pipe (Insulated)		Copper or Light Gauge Stainless Steel Pipe (Insulated)		Iron Pipe	
	horizontal	vertical	horizontal	vertical	horizontal	vertical
Up to 15	1.8	2.4	1.2	1.8	-	-
20	2.4	3.0	1.2	1.8	-	-
25	2.4	3.0	1.5	2.4	-	-
32	2.4	3.0	1.8	3.0	-	-
40	2.4	3.7	1.8	3.0	-	-
50	2.4	3.7	1.8	3.0	1.8	1.8
65	3.0	4.6	2.4	3.7	-	-
80	3.0	4.6	2.4	3.7	2.7	2.7
100	3.0	4.6	2.4	3.7	2.7	2.7
125	3.7	5.5	3.0	3.7	-	-
150	4.5	5.5	3.7	3.7	3.7	3.7
200	6.0	8.5	-	-	3.7	3.7
250	6.5	9.0	-	-	4.5	5.4
300	7.0	10.0	-	-	8.0	10.0
350	10.0	12.0	-	-	-	-
400	10.5	12.6	-	-	-	-
450	11.0	13.2	-	-	-	-
500	12.0	14.4	-	-	-	-
600	14.0	16.8	-	-	-	-

Pipe OD	Maximum Support Spacing (m) PVC or ABS Pipe Contents up to 20°C	
	Horizontal	Vertical
15	0.8	1.2
20	0.8	1.2
25	0.9	1.3
32	1.0	1.5
40	1.1	1.6
50	1.3	1.9
80	1.6	2.4
100	1.9	2.8
150	2.1	3.0
200	2.4	3.6
250	2.6	3.9
300	2.8	4.2

PIPE BORE	PE PIPE		GLASS PIPE	
(mm)	Type 32	Type 50		
nominal	horiz	horiz	horiz	horiz
up to 10	0.3	0.45	-	-

15	0.4	0.6	-	-
20	0.4	0.6	-	-
25	0.4	0.6	-	-
32	0.45	0.7	-	-
40	0.45	0.7	0.9	1.7
50	0.55	0.85	1.2	1.7
65	0.55	0.85	-	-
80	0.6	0.9	1.2	1.7
100	0.7	1.1	1.2	1.7
125	-	-	-	-
150	-	1.3	1.2	1.7
175	-	-	-	-
200	-	-	-	-
225	-	-	-	-
250	-	-	-	-
300	-	-	-	-
350	-	-	-	-
400	-	-	-	-
450	-	-	-	-
above 450	-	-	-	-

Maximum horizontal support spacing for grooved steel pipe

6.0m when jointed with flexible type mechanical joints.

10m when using flexible couplings, sleeve type.

For grooved steel and copper pipe, no individual pipe length should be left unsupported.

Vertical support spacing

Check total self-weight and pressure loading against manufacturer's recommendations when using mechanical joints or end load capable flexible couplings. Ensure adequate pipe support when using non-end load capable flexible couplings.

Space vertical support intervals for plastics pipe at not greater than twice horizontal intervals tabulated.

Space external vertical PE gas pipes in accordance with the current edition of IGEM/UP/2

Space horizontal and vertical pliable corrugated stainless steel gas pipes in accordance with the current edition of IGEM/UP/2.

Space LPG pipework in accordance with BS EN 16125.

Where multiple pipe runs of differing bores are supported from a common point, use support spacing of pipe requiring closest spacing.

Spacings given for PVC U pipe to BS EN ISO 1452 are for 20°C ambient or working temperature. Reduce spacing between supports for temperatures above 20°C. Support continuously for temperatures 60°C and above.

4231 ISOLATION AND REGULATION:

Provide valves, cocks and stop taps for isolation and/or regulation where indicated, and on:

Mains to isolate major sections of distribution.

Branch feeds to floors from risers.

The base of all risers and drops except in cases where one item of apparatus only is served which has its own local valve or stop tap.

Points of pipe connection of all items of apparatus and equipment except where the item could conveniently be isolated or regulated by valves provided for other adjacent items.

At all terminal units.

Draw-off fittings except where ranges of fittings are served by a common float, the isolator then being fitted with the float.

4241 MAINTENANCE AND RENEWAL:
Arrange pipework, valves, drains, air vents, demountable joints, supports, etc., for convenient routine maintenance and renewals. Ensure that the location of pipelines, wiring and wireways does not hinder or prevent the maintenance or removal of removable equipment such as cooling coils, filters etc.
Provide all runs with a regularly spaced pattern of demountable joints in the form of unions, flanges, etc., and also at items of equipment to facilitate disconnection.
Locate valves, drains, flanges etc. in groups.

4250 CLEANING:
Remove cement and clean off all pipework and brackets.

4260 NON-FERROUS COMPONENTS:
Thoroughly clean and degrease.

4401 PROTECTION OF UNDERGROUND PIPEWORK:
Protect buried gas pipework and other pipework where indicated, against corrosion by the application of a compatible anti-corrosive, non-cracking, non-hardening waterproof sealing tape. Apply, after cleaning pipework, by wrapping contrawise with two layers spirally around the pipe, ensuring a 50% minimum overlap.

4411 PROTECTION OF BURIED PIPES:
Provide earth cover as follows
Water pipework
900 mm minimum; 1200 mm maximum where practicable.
Fuel oil and gas
500 mm minimum.
Under roadways
Provide minimum cover of 900 mm.
Provide a marker tape to identify buried pipe services.

4420 PROTECTION OF PIPES IN SCREEDS:
Wrap pipework with two protective tapes prior to laying.
or Sheath pipework with PVC.

4430 CORROSION PROTECTIVE TAPE:
Apply basic cotton carrier tape saturated with petroleum hydrocarbons with inert siliceous fillers. Wind tape spirally contrawise round pipework applied and overlapped to manufacturer's recommendations.

4440 MECHANICAL PROTECTIVE TAPE:
Apply Hessian based bitumenous tape over the corrosion protective tape. Wind tape spirally contrawise round pipework applied and overlapped to manufacturer's recommendations.

4480 STEELWORK GALVANIZED AFTER MANUFACTURE:
Where indicated galvanize steelwork after manufacture.

4490 NON-FERROUS COMPONENTS:
Thoroughly clean and degrease.

5000 WORKMANSHIP, STEEL PIPEWORK:

5011 WELDING GENERAL, CLASS 1:

Use skilled craftsman in possession of a current Certificate of Competence appropriate to type and class of work, issued by an approved authority. Mark each weld to identify operative. Submit specimen welds, representative of joints and conditions of site welding, for each craftsman. Test non-destructively, approximately 10% of butt weld joints and 5% of all other joints, including prefabricated works as scheduled.
Weld pipeline joints to BS 2633.
Undertake non destructive testing in accordance with BS EN ISO 17636 or BS EN ISO 17640 and BESA TR/5

5012 WELDING GENERAL, CLASS 2:

Use skilled craftsman in possession of a current Certificate of Competence appropriate to type and class of work, issued by an approved authority. Mark each weld to identify operative. Submit specimen welds, representative of joints and conditions of site welding, for each craftsman. Test non-destructively, approximately 10% of butt weld joints and 5% of all other joints, including prefabricated works as scheduled.
Weld pipeline joints to BS 2971 and to BESA Code of Practice TR/5, Welding of Carbon Steel Pipework, as appropriate.
Undertake non-destructive testing in accordance with relevant part of BS EN ISO 17636 or BS EN ISO 17640 and BESA TR/5

5020 WELDED JOINTS, STEEL PIPES:

N/A

5030 PAINTING WELDED JOINTS, STEEL PIPES:

N/A

5040 FLANGED JOINTS, STEEL PIPES:

Welded Flanges

Weld neck and bore of 'slip on' flange.

Butt weld neck of welding neck flange.

Screwed Flanges

Apply jointing materials. Screw on flange and expand tube into flange with roller expander where necessary.

Preparation

Ensure that flange mating faces are parallel; flange peripheries are flush with each other; and bolt holes are correctly aligned.

Making and Sealing

Insert jointing between flange mating faces. Pull up joint equally all round.

5050 SCREWED JOINTS, STEEL PIPES:

Preparation

Ensure that plain ends are cut square. Reamer out bore at plain ends. Screw plain ends, taper thread.

Making and Sealing

Coat male pipe threads with jointing compound and hemp, or PTFE tape on small sizes. Immediately after applying coating, connect with female end of socket or fitting, and tighten ensuring that coating does not intrude into pipe. Leave joint clean.

5060 N/A

5081 PRESS FITTING AND PUSH FITTING JOINTS:

Make press fitting and push fitting joints in accordance with manufacturer's recommendations. Ensure all fittings are electrically continuous when the jointing process is complete. Ensure all on site operatives receive adequate training from the system manufacturers prior to commencing work on site and are issued with an appropriate ID card to validate this training Debur inside and outside of pipe using the manufacturer' proprietary de-burer where available. Using a manufacturers insertion depth gauge / proprietary tool mark the insertion distance on the pipe before making a joint. On completion of a joint mark with a paint check mark.

Comply with IGEM/UP/2 edition 3 Appendix 8 pressed fittings jointing procedure when used on natural gas pipework.

5090 STEEL PIPEWORK PAINTING:

Remove scale, rust or temporary protective coating by chipping, wire brushing or use of approved solvents and paint with one coat of red oxide primer, as work proceeds.

5091 STEELWORK PAINTING:

Prepare supports, bearers and other uncovered steelwork as steel pipework.
Where not exposed, paint with one coat zinc chromate or red oxide primer.

5100 COMPRESSION JOINTS, STAINLESS STEEL PIPES:

Use BS EN 1254 – 2 Type 'A' fittings.

Preparation

Ensure that plain ends are cut square. Reamer out bore at plain ends to full bore size. Clean plain ends with fine steel wool.

Making and Sealing

In accordance with fitting manufacturer's instructions.

5110 CAPILLARY JOINTS, STAINLESS STEEL PIPES:

Preparation

Ensure that plain ends are cut square. Reamer out bore at plain ends to full bore size and clean plain ends.

Making and sealing

Use a suitable phosphoric acid based flux to BS 5245. Make joint in accordance with manufacturer's instructions. Clean off traces of flux when joint is completed. Use end fed fittings only where indicated, using silver brazing alloy and flux to manufacturer's recommendations.

5120 BRAZED JOINTS, STAINLESS STEEL JOINTS:

Preparation

Prepare for brazing in accordance with BS EN 14324

Making and Sealing

Use flame heat and make in accordance with BS EN 14324 Use nickel bearing zinc free filler metals.

6000 WORKMANSHIP, COPPER PIPEWORK:

6010 WELDING GENERAL:

Use skilled craftsman in possession of a current Certificate of Competence appropriate to type and class of work, issued by an approved authority. Mark each weld to identify operative. Submit specimen welds, representative of joints and conditions of site welding, for each craftsman, test non-destructively, approximately 10% of buttweld joints and 5% of all other joints.

6030 COMPRESSION JOINTS, COPPER PIPES, LIGHT GAUGE:

Preparation for fittings to BS EN 1254 – 2

Type “A” fitting

Ensure that plain ends are cut square. Reamer out bore at plain ends to full bore size. Clean plain ends with fine steel wool or fine sandpaper

Type `B' fitting

Ensure that plain ends are cut square. Reamer out bore at plain ends to full bore size. Clean plain ends with fine steel wool or fine sandpaper, then comply with manufacturer's instructions.

Making and Sealing

In accordance with fitting manufacturer's instructions.

6040 CAPILLARY JOINTS, COPPER PIPES, LIGHT GAUGE:

N/A

6050 BRAZED JOINTS, COPPER / COPPER ALLOY PIPES:

Preparation

Prepare for brazing in accordance with BS EN 14324 Use manufactured fittings not subject to dezincification and suitable for application.

Making and Sealing

Use flame heat and make in accordance with BS EN 14324 Use silver brazing filler alloy suitable for application.

6060 ANCHORS, COPPER PIPES, FLANGES:

Provide anchors constructed by fitting two flanges to copper female adapters in pipe run at anchor point. Bolt together through an interposed mild steel channel section attached to or grouted into building structure.

or

Anchor pipework using saddle clamps to mild steel channel section attached to or built into building structure.

6070 MECHANICAL JOINTS, GROVED COPPER PIPES:

N/A

6081 PRESS FITTING AND PUSH FITTING SYSTEMS:

Make press fitting and push fitting joints in accordance with manufacturer's recommendations. Ensure all fittings are electrically continuous when the jointing process is complete. Ensure all on site operatives receive adequate training from the system manufacturers prior to commencing work on site and are issued with an appropriate ID card to validate this training Debur inside and outside of pipe using the manufacturer' proprietary de-burer where available. Using a manufacturers insertion depth gauge / proprietary tool mark the insertion distance on the pipe before making a joint. On completion of a joint mark with a paint check mark. Comply with IGEM/UP/2 edition 3 Appendix 8 pressed fittings jointing procedure when used on natural gas pipework.

7000 WORKMANSHIP, CAST/DUCTILE IRON:

7010 FLANGED JOINTS, CAST IRON/DUCTILE IRON PIPES:

N/A

7020 CAULKED JOINTS, CAST IRON/SPUN CAST IRON PIPES:

N/A

7030 FLEXIBLE JOINTS, CAST IRON PIPES:

N/A

8000 WORKMANSHIP, PLASTICS PIPES:

Comply with the requirements of BESA TR11.

8005 THERMOPLASTIC PIPING SYSTEMS FOR SOIL AND WASTE DISCHARGE:

For soil and waste discharge piping inside buildings comply with recommendations in PD CEN/TR 13801 and general installation practice given in BS EN 12056 Parts 1-5.

8006 THERMOPLASTIC PIPING SYSTEMS FOR HOT AND COLD WATER AND HEATING:

Install polybutylene and cross linked polyethylene pipes and associated fittings to all parts of BS 7291 in accordance with BS 5955-8 and the manufacturer's recommendations.

8010 SOLVENT WELDED JOINTS, PVC PIPES:

Use solvent welded joints generally, ring seal joints at expansion joints and elsewhere as necessary.

Preparation

Ensure that plain ends are cut square. Reamer out bore at plain ends. Clean plain ends with solvent cleaner.

Making and Sealing

In accordance with fitting manufacturer's instructions.

8020 FUSION JOINTS, POLYETHYLENE PIPES:

Preparation

Square cut plain ends. Form pipe ends for socket type joints.

Making and Sealing

In accordance with fitting manufacturer's instructions.

Carry out butt fusion jointing of pipes and fittings in accordance with the manufacturer's instructions.

8030 MECHANICAL FITTINGS FOR POLYETHYLENE PIPE:

Preparation

Ensure that cut ends are square. Check wall thickness/pressure rating of fitting.

Making and sealing

Ensure correct gasket type is used for service (e.g. water or gas). Assemble fitting in accordance with manufacturer's instructions.

8040 ANCHORS, PVC PIPES

Clamp pipework to mild steel channel section attached to or grouted into building structure, using PVC coated overstraps, or clamps and with a polypropylene strip between pipe and mild steel section.

8060 COMPRESSION FITTINGS ON MULTI-LAYER PIPES:

Carry out the installation of compression fittings on multi-layer pipe in accordance with manufacturer's recommendations.

9000 WORKMANSHIP (PROTECTION / MISC)

9010 FLEXIBLE COUPLINGS AND FLANGE ADAPTERS, SLEEVE TYPE:

Preparation

Ensure that cut ends are square and free of bumps, dents and score marks and are within manufacturer's tolerances.

Making and sealing

Ensure gasket is suitable for service. Thoroughly lubricate gasket using manufacturer's recommended lubricant. Assemble coupling in accordance with manufacturer's instructions.

For non-end load capable couplings, ensure that adequate pipe anchorage is provided to prevent pipe disengagement.

9021 STEAM AND CONDENSATE MAINS:

N/A

9030 PROTECTION OF UNDERGROUND PIPEWORK:

N/A

9040 PROTECTION OF BURIED PIPES:

Provide earth cover as follows

Water 750mm minimum (900 -1200mm maximum where practical)

Gas 600mm (footway), 750mm (verge), 750mm (carriageway).

Fuel oil 900mm

Install in accordance with latest revision of NJUG Guides:

Utilities Guidelines on Positioning and Colour Coding of Apparatus

Guidelines for the Planning, Installation and Maintenance of Utility Services in Proximity to Trees

Install PVC marker tapes to all trenches as detailed below.
All services to be 900mm under roadways.
Provide a marker tape to identify buried pipe services as indicated.

9050 PROTECTION OF PIPES IN SCREEDS:

Wrap pipework with two protective tapes prior to laying or
Sheath copper pipework with PVC or LDPE.

9060 INSTALLATION OF THERMALLY INSULATED UNDERGROUND PIPELINES:

Install pre-insulated bonded steel pipelines to BS EN 253, BS EN 448, BS EN 488 and BS EN 489-1 or BS EN 15698-1 (pipe assemblies) and BS EN 15698-2 (fitting and valve assembles) for twin pipe systems in accordance with manufacturer's instructions and BS EN 13941-2.

Install pre-insulated bonded flexible pipe system to BS EN 15632-1 and BS EN 15632-2, with plastic service pipes in accordance with manufacturer's instructions.

Install pre-insulated non bonded flexible pipe system with plastic service pipes to BS EN 15632-1 and BS EN 15632-3 in accordance with manufacturer's instructions.

Install pre-insulated bonded flexible pipe system with metal service pipes to BS EN 15632-1 and BS EN 15632-4 in accordance with manufacturer's instructions.

9100 CORROSION PROTECTIVE TAPE:

Apply basic cotton carrier tape saturated with petroleum hydrocarbons with inert siliceous fillers. Wind tape spirally contra wise round pipework applied and overlapped to manufacturer's recommendations.

9110 MECHANICAL PROTECTIVE TAPE:

Apply Hessian based bituminous tape over the corrosion protective tape. Wind tape spirally contra wise round pipework applied and overlapped to manufacturer's recommendations.

9120A STEELWORK PAINTING:

Prepare supports, bearers and other uncovered steelwork as steel pipework.
Where not exposed, paint with one coat zinc chromate red oxide primer.
Where exposed, paint all cut ends of hangars, etc with two coats of zinc rich primer. Cut all hangar rods close to backnuts and paint as hangars.

10000 Based on NES Y10 TEXT Dec 19

1001 GENERAL [based on NES 211.010]

The tender drawings show the design intent and do not necessarily show all facilities for filling, draining, flushing, cleaning, draining and chemical cleaning of the water systems.

The Contractor shall include in the installation all necessary facilities, including sample coolers (if required) , to enable a Specialist to successfully fill, flush, clean, and chemically treat the systems listed in schedule Y25 in accordance with the latest edition of BSRIA Guide BG29 “Pre-commissioning cleaning of pipework systems.

Where 2 port control valves and PICV’s are installed and the a orifice of the control valve is too small to allow adequate flow for back flushing a drain point shall be located between the two-port valve and the coil connection.

The Contractor shall review all designs to ensure that systems are commissionable in accordance with the CIBSE commissioning code W and BSRIA Guide BG2/2010 as detailed in Y51. If additional facilities are required the Contractor shall advise the designer prior to commencing work on site.

All fittings, pipe joints and flanges PN rating shall be suitable for hydraulic test pressure of the system (ie minimum of 1.5 times the maximum operating pressure).

For applicable valves comply with BS EN 16668 for all essential safety requirements of the Pressure Equipment (Safety) Regulations 2016. Valves excluded from conformance to this standard in the Regulations shall meet "sound engineering practice" by conformity to the relevant product standard.

Face to face and centre to face dimension of PN and Class designated flanged metal valves to be in accordance with BS EN 558.

Marking

In accordance with BS EN 19 or BS ISO 5209 for general purpose industrial metallic valves

Plastic valves to be marked in accordance with the appropriate valve standard.

Wall thickness of valve bodies, bonnets and covers to be determined in accordance with the appropriate part of BS EN 12516

In addition to the particular valve type standard, valves to be used in, or connected to, water supply pipe systems, above or below ground carrying water intended for human consumption to comply with the relevant parts of BS EN 1074 and BS 5163 as appropriate to the application.

BS EN 1074-1 - General requirements
BS EN 1074-2 - Isolating valves
BS EN 1074-3 - Check valves
BS EN 1074-4 - Air valves
BS EN 1074-5 - Control valves
BS EN 1074-6 – Hydrants

Valves and components of valves specified are as defined in BS EN 736-1 (types of valves) and BS EN 736-2 (components).

1010 SAFETY DEVICES AND RELIEF VALVES - SELF OPERATED - APPLICATION:

Safety

To discharge with rapid opening action to prevent predetermined safe pressure being exceeded.

Relief

To discharge with opening action proportional to increase in pressure above set pressure.

Select, supply and install safety devices in accordance with relevant parts of BS EN ISO 4126 to suit the project particular requirements.

1020 EXPOSED VALVES:

Fit easy-clean covers over glands and bonnets to small copper alloy valves exposed in areas other than plant rooms. Fit thermoplastic valve wheels. Fit dust caps to lockshield valves.

1030 TESTING [based on NES 211.010]:

Ensure that valves and cocks are pressure tested at manufacturer's works, in accordance with specific requirements of the valve product or performance standard. Pressure test valves in accordance with BS EN 12266-1 or BS ISO 5208. Undertake supplementary tests as necessary in accordance with BS EN 12266-2.

Pressure test thermoplastic valves at manufacturer's works, in accordance with BS ISO 9393-1 in conjunction with given specific requirements of the valve product or performance standard. For valves used for volatile air pollutants and hazardous fluids, test for external leakage in accordance with relevant parts of BS EN ISO 15848.

1040 VALVE REMOVAL

All valves used on water services installations shall be provided with means of disconnection. Screwed or capillary valves shall be fitted with unions either side. Compression ended valves shall only be used for final isolation or where easily accessible.

2000 PRODUCTS/MATERIALS

2005 VALVE ENDS

Ends of valves shall suit the pipelines into which they are installed.

2007 STOP VALVES - SLUICE TYPE TO BS 5163:

Valve type (as BS) - A
Application – Waterworks purposes
Ends
Flanged to BS EN 1092
Seat
Metal seated.
Stem seal
Stuffing box and gland.
Operation
Handwheel.
Materials
Manufacturer's standard.
or As otherwise indicated.
Options
Stem cap.

2015 STOP VALVES (STOP COCK) TO BS EN 1213 FOR POTABLE WATER SUPPLIES:

Material - copper alloy.
Flow rate class
VA (straight and angle pattern stop valves).
VB (oblique pattern stop valves).
End connections
Compression to BS EN 1254-2. or Compression to BS EN 1254-3 or Capillary to BS EN 1254-1. or Threaded to Relevant parts of BS EN 10226 .

2016 MANUALLY OPERATED VALVES FOR GAS:

N/A

2021 STOP VALVES – COPPER ALLOY GATE TYPE TO BS EN 12288:

Gate valve type
Solid or split wedge
Ends
Threaded to Relevant parts of BS EN 10226 or Flanged to BS EN 1092
Stem
Inside screw non rising stem or outside screw non rising stem.
Trim material
Suitable for potable water supply.
Operation
Handwheel
Options
Position indicator.
Locking device.

2031 STOP VALVES – CAST IRON GATE TYPE TO BS EN 1171:

Valve type

Solid or split wedge.
Inside screw stem (non-rising).

Stem sealing
Stuffing box and gland.

Ends
Flanged to BS EN 1092-2. PN as indicated

Body and bonnet material
Grey cast iron or SG iron as scheduled or to suit the pressure/temperature application

Trim category
Copper alloy faced.

Operation
Handwheel.

Suitable for use with potable water.

Options
Position Indicator.
Locking device.

2061 PARALLEL SLIDE VALVES TO BS EN 1984:

Material – Steel
Application – Steam and HTHW
Ends - Flanged BS EN 1092-2 or butt-weld with dimensions of ends to BS EN 12627 as indicated.
Stem - Rising stem.
Valve faces - Stainless steel disc and seat.

2081 STOP VALVES - BALL TYPE:

Standards / application / material
Potable water - copper alloy to BS EN 13828, PN 10 and distribution temperature of 65 °C with occasional excursions up to 90 °C permitted for a period of 1 hour maximum.
General purpose heating, cooling and other applications - copper alloy to BS EN 13547.
Industrial and high temperature / pressure applications - steel ball valves to BS EN 1983
Steam and high temperature / pressure applications - carbon steel to BS ISO 7121 - reference Y11.2161.
Gas - to BS EN 331.

Ends - Threaded to Relevant parts of BS EN 10226 or grooved or flanged as scheduled.
Chrome or nickel plated DZR sphere with full bore flow aperture. PTFE seats and stem seals. Anti-blowout stem.

Operation - lever operated or screw driver operated or key operated.
For hot and cold water applications to BS EN 13828, incorporate a flow regulator within the isolation valve where the static pressure exceeds 1 bar.

2085z SERVICING VALVES TO BS 6675

Material - copper alloy.

End connections
Compression to BS EN 1254-2 or Compression to BS EN 1254-3 or Capillary to BS EN 1254-1 or threaded to Relevant parts of BS EN 10226 .

Operation – as indicated on drawings.

2090z STOP VALVES - BUTTERFLY TYPE TO BS EN 593:

Construction
Provide controlled elastomer compression on flange faces.
Semi-lugged, l wafer type design or grooved type capable of dead end service and bi-directional service, with disc offset from stem. Grooves for 350mm and larger to be wedge shaped, for example, Victaulic advanced groove system (AGS).
For installation between flanged pipework connections, body to suit BS EN 1092.
Provide lever-operated valves with long body neck for lagging clearance.

Seat - bonded. pressure responsive elastomer in sizes up to 300mm, disc mounted seal for 350mm and larger.

Materials
Ductile iron or Carbon Steel or stainless steel body to suit application and operating pressure / temperature conditions.
Stainless steel shaft.

Disc material suitable for service fluid and operating temperature.
EPDM seat
Body lining material suitable for service fluid and operating temperature. For potable services the linings shall be arranged such that the fluid is not in contact with any ferrous parts.

Operation

Lever and graduated notch plate up to 150mm. Gear box operator above 150mm. Unless otherwise indicated.

2121 STOP VALVES TO BS 5433

Application

Underground stop valves for water services

Material

Bronze or DZR copper alloy body threaded to relevant parts of BS EN 10226
Washer material suitable for service fluid and operating temperature Material

2127 THERMOPLASTIC VALVES (NES 211.032 / Y11.2126)

Standards

BS EN 15389 for performance characteristics
Relevant parts of BS ISO 9393 for pressure testing
BS EN ISO 16135 for the design and manufacture of ball valves
BS EN ISO 16136 for the design and manufacture of butterfly valves
BS EN ISO 16137 for the design and manufacture of check valves
BS EN ISO 16138 for the design and manufacture of diaphragm valves
BS EN ISO 16139 for the design and manufacture of gate valves
BS EN ISO 21787 for the design and manufacture of globe valves
For water supply and drainage to BS EN 12201-4
For gas supply to BS EN 1555-4

PN to suit system maximum working pressure.
WRAS approved for water services applications.

2130 STOP VALVES - LUBRICATED PLUG COCK TYPE TO BS 5158:

Materials

Cast Iron

Pattern

Short or regular.

Ends

Flanged to BS EN 1092-1 or BS EN 1092 -2 as indicated or screwed to Relevant parts of BS EN 10226

Body seat

Tapered or Parallel, or Plug fitted with injection facility for lubrication or sealing compound.

Operation

Wrench, but with wheel and gearbox where indicated.

Options

Provide manufacturer's charge of lubrication/ sealant suitable for service fluid and operating temperature.

2161 STOP VALVES - BALL TYPE TO BS ISO 7121:

Material

Carbon Steel or stainless steel body as scheduled

Pattern

Full bore.

Ends - threaded to relevant parts of BS EN 10226 unless detailed otherwise elsewhere.
(Socket weld ends to be to BS ISO 7121 or BS EN 12627 & butt welding ends to BS ISO 7121).

Operation

Wrench.

Trim material

Manufacturer's standard.

Options

Wrench.

2170 STOP VALVES - DIAPHRAGM TYPE TO BS EN 13397:

Pattern - Weir.
Ends -Flanged to BS EN 1092-1 or BS EN 1092-2 or BS EN 1092-4 PN as indicated or Threaded to Relevant parts of BS EN 10226
Materials
Suitable for service fluid and operating temperature.
Operation
Hand wheel.
Options
Sealed bonnet.

2210 REGULATING VALVES - BUTTERFLY TYPE:

Standard - BS EN 593.
Construction
Provide controlled elastomer compression on flange faces.
Fully lugged wafer type design or grooved type capable of dead end service and bi-directional service, with disc offset from stem.
For installation between flanged pipework
Body flanged to suit BS EN 1092
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.
Disc material suitable for service fluid and operating temperature.
EPDM seat.
Body lining material suitable for service fluid and operating temperature.
Operation
Infinitely variable setting with travel stops and position indicator.
Gear box operation.

2221 DOUBLE REGULATING VALVES - GLOBE TYPE TO BS 7350:

Series (as BS) - B.
Material
Copper Alloy to BS 5154
or cast iron to BS EN 13789 as scheduled
Pattern
Oblique or Y. Flanged to BS EN 1092 – 2 or BS EN 1092-3 or screwed to Relevant parts of BS EN 10226 or grooved
Stem
Inside screw rising stem.
or Outside screw rising stem.
Trim material
Suitable for potable water supply.
Operation
Lockshield.
Options
Regulating locking device to
Provide double regulating facility.

2230A 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
Threaded to Relevant parts of BS EN 10226 or flanged to BS EN 1092-2 to match pipework as indicated.
Material

Double regulating globe valve, bronze or DZR copper alloy to BS 5154 series B and close coupled fixed orifice fitting to BS 7350 table 6.

Options

Independent means for positive isolation on pressure tapping or adapter.

2230C 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 or butterfly valve.

Ends - Flanged to BS EN 1092-2.

Material

Double regulating globe valve, cast iron 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.

2240 ORIFICE PLATE:

Material

Stainless steel.

Carrier ring to fit inside bolt circle of flange.

or Carrier ring full faced for installation between copper alloy flanges.

Pressure tappings with self-sealing test plugs, suitable for operating conditions, for connection to manometer to provide measuring facility

2241 TERMINAL UNIT MANIFOLD COMMISSIONING MODULES:

A multi terminal commissioning system for controlling up to 6 terminal units served by either 15mm or 20mm flow measuring stations / pipework. For duties refer to drawings and terminal unit schedules.

All components to be assembled and installed in an insulated painted galvanised sheet steel box having a minimum thickness of 1.2mm incorporating handles, a clamped lid for access and external hanging points. Insulation to be a minimum thickness of 20mm and ensure the box is completely vapour sealed.

Modules are to incorporate a flushing bypass, isolation valves, and strainer with integral drain cock, pressure test points, flow isolating valves and return flow measuring / regulation valves as clause 2230A. When used on variable volume systems an adjustable differential pressure control valve or PICV shall also be installed within the box, as indicted on the drawings.

Connections to flow & return pipes are to be BSP Threaded Female and accessible on the outside of the box to prevent disturbing the insulation.

Each module to be supplied with an identification label, identifying each manifold with flow/return designation, terminal numbers and flow rates.

2260A RADIATOR VALVES TO BS 2767

Type - Use type 4 or type 10 as required to meet system temperature and pressure

Material - Bronze or DZR copper alloy body.

Pattern - Angle or straight to suit application.

Pipework Connections - Straight

Threaded to Relevant parts of BS EN 10226

or compression to BS EN 1254-2 to suit pipework as indicated.

Angle

Threaded to Relevant parts of BS EN 10226 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 with union nut and tail pipe to suit pipework as indicated.

Connections

Fit wheel valves on flow connections to radiators, and other heat emitters, without thermostatic radiator valves. Fit lockshield valves on return connections.

2270 THERMOSTATIC RADIATOR VALVES:

Standard

BS EN 215 for requirements, dimensions and testing of valves in wet central heating systems up to 120°C and 10 bar.
Materials and connections as radiator valves.
Pattern - Angle or straight to suit application, valves to be tamper proof.
Ancillaries
Position indicator.
Locking device.
Temperature sensor
Unless scheduled otherwise:
Sensor head to be integral with an alpha/numeric set point indicator and complete with tamperproof / locking facility
or Remote sensor with an integral alpha/numeric/temperature set-point indicator; integral locking facility, and capillary connections between sensor and valve, or remote sensor incorporating the selector as indicated on the drawings.

2290A FLOAT OPERATED VALVES, BALANCED EQUILIBRIUM:
Bronze or DZR copper alloy body.
Inlet
Threaded to Relevant parts of BS EN 10226 or flanged to BS EN 1092 as indicated.
Spindle and head effectively guided and arranged with stops to engage with valve body and prevent over travel. Linkage fulcrum adjustable relative to vertical plane, securely locked to body tapping when set. Screwed plug from access cover.
Float and lever arm.
Spun copper float, halves brazed or welded together, with centre sleeve connecting to lever arm.
For feed and expansion application use long arm type arranged to close when tank contains 150mm depth.
WRAS approved.

2300z FLOAT OPERATED VALVES - DELAYED ACTION TYPE:
Incorporating
: Float operated valve.
: Canister - copper.
: Secondary float - gunmetal.
: Support bracket - galvanized steel.

2320z SWING CHECK VALVES TO BS 5154
Material
Copper Alloy
Series B; horizontal pattern.
Ends
Threaded to relevant parts of BS EN 10226 or flanged to BS EN 1092 to suit pipework as indicated.
Trim material - Manufacturer's standard.
To be suitable for potable water where required

2330z SWING CHECK VALVES TO BS EN 16767
Type – As defined in BS EN 736-1
Material
Cast iron unless scheduled otherwise
Pattern - Straight pattern, horizontal.
Valve face - Copper or nickel alloy.
Ends - Flanged to BS EN 1092-2 or grooved.
Material - Manufacturer's standard.

To be suitable for potable water where required.

2371 CHECK VALVES GLOBE STOP AND CHECK TYPE:
Standard - Steel - BS EN 13709.
Pattern - Straight or Angle as indicated.
Ends -Flanged to BS EN 1092-1 PN to suit system operating temperature / pressure.
Materials - Manufacturer's standard to suit fluid and operating conditions.

2385 DEVICES TO PREVENT CONTAMINATION OF WATER BY BACKFLOW:
BS EN 13959 - check valves.
BS EN 14451 - terminal anti-vacuum valves.
BS EN 14451 - in-line anti-vacuum valves.
BS EN 14451 -combined check and anti-vacuum valves.
WRAS approval.
Ends Compression connections to BS EN 1254-2 or Threaded to Relevant parts of BS EN 10226

2390A COMBINED CHECK AND ANTI-VACUUM TYPE ANTI BACK SIPHONAGE VALVES:
Bronze or DZR copper alloy body assembly with compression connections to BS EN 1254-2. or threaded to relevant parts of BS EN 10226 (horizontal or vertical)
WRAS approval
Pattern : In-line pattern or side inlet bottom outlet or bottom inlet side outlet as indicated.
Components
Stainless steel domed air inlet. Non-return valve with plastic body, rubber actuator and stainless steel to plastic seal.

2391A HOSE UNION ANTI-VACUUM TYPE ANTI BACK SIPHONAGE VALVES:
Bronze or DZR copper alloy body assembly with fittings to BS EN ISO 228-1.
Pattern - In line pattern.
Sizes - DN15 to DN25.
WRAS Approval

2395A VERIFIABLE BACKFLOW PREVENTER WITH REDUCED PRESSURE ZONE (RPZ) VALVE GENERAL REQUIREMENTS:
Provide an application to the local water supplier using the WRAS “RPZ Valve Assembly - Application for Installation” form.
Obtain Water Supplier agreement that a Type BA device is a suitable means of backflow protection in the water supply system under consideration.
Test methods and maintenance regimes shall be in accordance with the Water Suppliers requirements and any failure to comply may result in termination of supply or removal of the device. These maintenance requirements must be detailed within the project Operation & Maintenance documentation.
The fitting must be included in the WRAS “Water Fittings and Materials Directory” and satisfy the requirements of the Regulations.
The installer must obtain formal Water Supplier agreement that a Type BA device is a suitable means of backflow protection in the plumbing system under consideration before installation.
Confirm that any Type BA device installed provides protection against back pressure and back siphonage at the point of use from fluids up to and including Category 4 as defined in:
England and Wales - The Water Supply (Water Fittings) Regulations 1999, the Water Act 2014 and the Construction Products Regulations 2013.
Scotland - The Water Supply (Water Fittings) Byelaws 2014.
Northern Ireland - The Water Supply (Water Fittings) Regulations (Northern Ireland) 2009.
Comply with the stipulations and requirements set out in WRAS Approved installation method Document AIM-08-1.

2395B VERIFIABLE BACKFLOW PREVENTER WITH REDUCED PRESSURE ZONE (RPZ) VALVE INSTALLATION:
The Type BA device shall not be installed in a place or position which is:
Liable to flooding
Above electrical equipment

Exposed to freezing - unless measures are taken to prevent the assembly from freezing

The assembly shall be:
Installed horizontally with the relief valve discharging downwards. Inline strainers shall be fitted downstream of the inlet isolating valve and immediately upstream of the device - to prevent fouling of elements of the assembly.
The valve shall be Installed not less than 300mm above ground or floor level or the base of any cabinet to the underside of the exit port of the relief valve and no more than 1500mm above ground or floor level. An air break shall be provided between the relief outlet port and the top of the allied tundish.
Following installation the assembly shall be flushed and disinfected in accordance with BS EN 806-4 and complimentary guidance in BS 8558.
Following flushing and prior to commissioning and site test, the assembly shall be checked by the installer to ensure that the relief valve functions correctly - in accordance with the guidelines in WRAS Approved installation method Document AIM-08-1.

2395C VERIFIABLE BACKFLOW PREVENTER WITH REDUCED PRESSURE ZONE (RPZ) VALVE ON SITE INSPECTION AND TESTING:
Site testing must only be carried out by an accredited tester approved by the Water Supplier.
Testing shall be carried out at intervals not exceeding 12 months.
Test data during the commissioning of the assembly and at subsequent intervals shall be entered on the "RPZ Valve Test Report Form" produced by the WRAS.
The inspections and testing shall be in accordance with WRAS Approved installation method Document AIM-08-1.
On completion of site tests, a certificate must be completed by the tester in accordance with WRAS Guidance Note and copies submitted to the water supplier and the person responsible for the device. Copies shall be included in the Operation and Maintenance Manuals, including interval periods for subsequent testing.

2395D VERIFIABLE BACKFLOW PREVENTER WITH REDUCED PRESSURE ZONE (RPZ) VALVE RECORD OF INSTALLATION AND TEST DATA:
Provide records for each assembly.
In general, the record shall indicate the following:
- Precise location of the assembly
- Purpose of the assembly
- Data pertaining to prescribed tests
- Frequency of tests
- Defects found and measures taken to remedy these defects
- Details of the person who carried out the test

The installation, commissioning and subsequent test data shall be forwarded to the Water Supplier and copies retained by the Tester and the Water Supplier's customer for a period of at least five years.

2400 PRESSURE REDUCING VALVES - INTEGRAL SENSOR TYPE:
Material
- Bronze or DZR copper alloy body threaded to relevant parts of BS EN 10226
- Stainless steel valve and seat and return spring.
- Phosphor bronze bellows.
  - unless otherwise indicated

Components
- Control spring and handwheel.
- Integral sensor with an alpha/numeric pressure set-point indicator and locking facility.

2422 IN LINE DIFFERENTIAL PRESSURE CONTROL VALVES - DIRECT ACTING TYPE:
Provide valves to maintain a constant differential pressure downstream of the valve across a specific zone, mounted in the return pipeline.
Material
- Cast iron Malleable iron body, brass or bronzebody.
- Stainless steel seat, cone and return spring.
- Phosphor bronze bellows.

Components
- Control spring and actuator.
- Valve body and bellows.

Connections
Threaded to relevant parts of BS EN 10226.
Or Flanged to BS EN 1092 parts 1,2 or as appropriate

2423 PRESSURE INPEPENDENT CONTROL VALVE (PICV): (NES 211.065)
Select, install and commission valves to provide the functions of flow limitation, modulating control and differential pressure control within a single valve body.
Commission valves in accordance with the manufacturer's recommendations and Commissioning Specialists Association TM18.
The valve manufacturer shall provide test results for each type and size of PICV to be used on the project in accordance with BSRIA Test Method for Pressure Independent Control Valves BTS 1/2012.
Limiting minimum operating pressure – 20Kpa.
For PICVs with a k_v value less than 0.4, a flushing drain should be incorporated in the pipework between the terminal unit and the PICV.
All PICVs' shall have an equal percentage control characteristic, be sized such that the design flow is within the setting range of the valve and be capable of closing against a maximum differential pressure that is greater than the pump head.
Type – Full stroke where the control and flow setting functions are separated within the valve and the full stroke of the valve is available for control (unless scheduled otherwise)
Valve characteristic/control - Equal percentage modulating (unless scheduled or described otherwise elsewhere in this specification).
Duties - To suit terminal unit design flow rates as detailed in equipment schedules.
Standard
Relevant parts of BS EN 60534
Valve leakage class to BS EN 60534-4 when shut off - IV.
Materials:
Body - DZR brass.
Globe or ball - brass.
Stem - brass.
O-Ring/diagram - EPDM rubber.
Springs - stainless steel.
Features - Facility to measure pressure drop across valves at commissioning.
Actuator - 0-10V proportional electric for modulating control or 3 point floating control.

2424 BYPASS DIFFERENTIAL PRESSURE CONTROL VALVES - DIRECT ACTING TYPE:
Provide valves to maintain a minimum circuit flow rate as system loads change.
Material
Cast iron Malleable iron body, brass or bronzebody.
Stainless steel seat, cone and return spring.
Phosphor bronze bellows.
Components
Control spring and actuator.
Valve body and bellows.
Connections
Threaded to Relevant parts of BS EN 10226.
Or Flanged to BS EN 1092 parts 1,2 or as appropriate

2430A DIRECT ACTING SAFETY VALVES COPPER ALLOY, SINGLE SPRING:
Material - Bronze or DZR copper alloy body.
Standard
BS EN ISO 4126-1, BS EN ISO 4126-7
Ends - Threaded to relevant parts of BS EN 10226.
Spring type - Single spring loaded, high lift type.
Protection from unauthorised adjustment
Fit a ferrule under adjusting screw.
or Fit compression ring under adjusting screw.
or Lock adjusting screw.

2430B DIRECT ACTING SAFETY VALVES COPPER ALLOY, DOUBLE SPRING:

Material - Bronze or DZR copper alloy body.
Standard
BS EN ISO 4126-1, BS EN ISO 4126-7
Ends - Threaded to relevant parts of BS EN 10226.
Spring type - Double spring loaded, high lift type.
Protection from unauthorised adjustment
Fit a ferrule under adjusting screw.
or Fit compression ring under adjusting screw.
or Lock adjusting screw.

2430C DIRECT ACTING SAFETY VALVES CAST IRON, SINGLE SPRING:

Material - Cast iron body.
Standard
BS EN ISO 4126-1, BS EN ISO 4126-7
Ends - Flanged to BS EN 1092-2
Spring type - Single spring loaded, high lift type.
Protection from unauthorised adjustment
Fit a ferrule under adjusting screw.
or Fit compression ring under adjusting screw.
or Lock adjusting screw.

2430D DIRECT ACTING SAFETY VALVES TO BS 6759, CAST IRON, DOUBLE SPRING:

Material - Cast iron body.
Ends - Flanged to BS EN 1092-2
Spring type - Double spring loaded, high lift type.
Protection from unauthorised adjustment
Fit a ferrule under adjusting screw.
or Fit compression ring under adjusting screw.
or Lock adjusting screw.

2440A DRAIN COCKS, THROUGHWAY GLAND COCK:

Standard – BS 2879
Bronze body with capilliary ends. Tapered plug with square shank for loose lever; bolted gland; strap and blank cap screwed on hand tight. Outlet to accept hose union. Locate at all low points

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 TWO WAY GLAND TYPE VENT COCK:

Bronze body threaded to relevant parts of BS EN 10226.
Tapered plug with square shank for loose lever.
Plug position indicator.
Bolted gland.

2490 THREE WAY GLAND TYPE VENT COCK:

Components
Bronze body threaded to relevant parts of BS EN 10226.
Tapered plug with square shank for loose lever.
Plug position indicator.
Port markings to indicate inlet, vent, waste.
Bolted gland.
Port configuration, T port with stops.

2500A THREE WAY PLUG VALVE VENT COCKS:

Cast iron body, plug and bottom cover. PTFE thrust washer.
Ends - Flanged to BS EN 1092-2
T port configuration with stops. Wrench operation.

2511 AUTOMATIC AIR VENTS - FLOAT TYPE:

Construction

Bronze or DZR copper alloy body with threaded inlet to Relevant parts of BS EN 10226.

Provide a solid polypropylene float and air release valve. Ensure valve is self closing.

Provide

Connection to air vent for piping away released air.
Isolating valve.
Integral non-return valve.

Operating conditions

Maximum temperature, 130°C.
Maximum pressure 10 bar.

2516 DEAERATION UNITS - MICROBUBBLE TYPE:

For systems with less than 15m static head on heating and 5m on Chilled water

Type

Inline Temperature Differential Deaerator

Construction

Vertical mild steel housing, fitted with non-clogging helicoidal separation tubes and mesh / packing manufactured from copper tube, stainless steel or other proprietary material to create a the correct environment at the top of the unit to deaerate efficiently by separating the smallest microbubbles.

Maximum operating temperature and pressure of 110^{o}C and 10 bar.g.
Units to be compliant with The Pressure Equipment Regulations 1999.
For Chilled Water systems, the Deaerator shall be suitably insulated to prevent condensation
Provide air release mechanism comprising a solid polypropylene float not rigidly coupled to the air release valve. The air release valve shall be self closing. The AAV shall incorporate a 3-way valve allowing positive shut off to the AAV for servicing and protection from dirt during filling / flushing.

Ends

Screwed or flanged to BS EN 1092- 1, PN to match pipework

All Deareation equipment must be manufactured and supplied by companies complying with the requirements of “Lloyds register quality assurance ISO9001”. A Certificate of Compliance must be issued by this company for approval prior to orders being placed.

2521 DEAERATION UNITS - PRESSURE –STEP or VACUUM DEGASSER TYPE

For systems with greater than 15m static head on heating and 5 m on Chilled water

Type

Packaged Pressure Step Differential Deaerator complete with pump, casing and all necessary electronic controls.
The unit shall incorporate the following controls: air monitoring - auto start/shutdown; re-start every day by time clock; pump “ant-stick” start every three days; volt-free contacts for connection to BMS for fault indication.
The Deaerator shall have a vessel, where a volume of water from the main system is exposed to a vacuum and an automatic air vent.
For Chilled Water systems, the Deaerator shall be suitably insulated to prevent condensation.
Maximum operating temperature - 90oC.
Operating pressure range shall be selected to suit the system requirements.
The Deaerator shall be commissioned by the manufacturers representative.
The Pressure Differential Deaerator shall be electronically controlled
All Deareation equipment must be manufactured and supplied by companies complying with the requirements of “Lloyds register quality assurance ISO9001”. A Certificate of compliance must be issued for approval by the engineer prior to orders being placed.

2523 DIRT SEPARATOR UNITS:

Construction
Vertical mild steel housing. To ensure Deaeration and Dirt Separation are achieved the unit shall be fitted with a non-clogging cluster of spiral tubes manufactured from copper tube and wire to create an the correct environment at the bottom of the unit for dirt separation to occur.
The Dirt Separator unit shall have a standard maximum operating temperature and pressure of 110oC and 10 bar.g. respectively.
Units to be compliant with The Pressure Equipment Regulations 1999.
The pressure drop across the Dirt separator shall remain constant regardless of the amount of dirt trapped.
Ends -Screwed or flanged to BS EN 1092- 1, PN to match pipework
Dirt separation equipment must be manufactured and supplied by companies complying with the requirements of "Lloyds register quality assurance ISO9001". A Certificate of compliance must be issued for approval by the engineer prior to orders being placed.

2524 COMBINED DEAERATOR & DIRT SEPARATOR:
For systems with less than 15 m static head on heating and 5 m on Chilled water
Type
Inline Combined Temperature Differential (microbubble) Deaerator & Dirt Separator .
Construction
Vertical mild steel housing, fitted with non-clogging helicoidal separation tubes and mesh / packing manufactured from copper tube, stainless steel or other proprietary material to create a the correct environment at the top of the unit to deaerate efficiently by separating the smallest microbubbles.
Maximum operating temperature and pressure of 110^{o}C and 10 bar.g.
Units to be compliant with The Pressure Equipment Regulations.
For Chilled Water systems, the Deaerator shall be suitably insulated to prevent condensation
Provide air release mechanism comprising a solid polypropylene float and air release valve. Ensure valve is self-closing.
Provide dirt drain valve at its lowest point.
Ends
Line size with flanges to BS EN 1092-1, PN to match pipework
All Deareation & Dirt separation equipment must be manufactured and supplied by companies complying with the requirements of "Lloyds register quality assurance ISO9001". A Certificate of compliance must be issued for approval by the engineer prior to orders being placed.

2530 STEAM TRAPS TRAP SETS AND ANCILLARIES: (based on NES 211.250)
N/A

2540 STEAM TRAPS - THERMOSTATIC TYPE, BALANCED PRESSURE:
N/A

2550 STEAM TRAPS - THERMOSTATIC TYPE, BI-METALLIC:
N/A

2560 STEAM TRAPS - FLOAT TYPE:
N/A

2570 STEAM TRAPS - THERMODYNAMIC TYPE:
N/A

2580 STEAM TRAPS - INVERTED BUCKET TYPE:
N/A

2582 STEAM TRAPS - VENTURI ORIFICE TYPE:
N/A

2584 AUTOMATIC PUMP TRAPS

N/A

2590 STEAM TRAP FAILURE INDICATORS:
N/A

2600 SIGHT GLASSES:
N/A

2611 EXPANSION LOOPS - STEEL:
N/A

2620 EXPANSION LOOPS - COPPER:
Where indicated provide expansion loop in material and finish of associated pipeline. Forge bend from a single length of pipe.
Where a grooved steel pipework system is used the loops shall be designed by the system manufacturer.
Loop sizes shall be calculated using the CIBSE guidance. Calculations shall be undertaken to establish stress contained in the loop.

2631 EXPANSION COMPENSATORS:
Type
Unrestrained - Axial.
Restrained – Lateral, Angular gimbal
Ends
Threaded to relevant parts of BS EN 10226.
or Flanged to BS EN 1092-1 PN to match pipework.

Standards
Joints shall comply with the requirements of the Expansion Joints Manufacturers Association standard 1998 (EMJA). Expansion joints may be of the restrained or unrestrained type.
Design, manufacture and install metal bellows expansion joints in accordance with BS EN 14917.

General
Expansion joint convolutions shall be of a thick wall spirally wound, multi-ply construction with a corrosion resistant inner ply in AISI 316L stainless steel. Units shall be fitted with stainless steel inner sleeves.
For critical services such as MTHW, HTHW and steam, the bellows shall have a weep hole as a fail-safe device.
Expansion joints shall be capable of not less than 5000 complete reversals of movement at the given working conditions and the manufacturer shall be able to produce calculations to that effect.
Expansion joints shall be capable of withstanding a test pressure 1.5 times their design pressure without deformation.
The Contractor shall ensure the expansion joints are installed in accordance with the manufacturer guidelines for selection and installation. The manufacturer shall issue a Certificate of Compliance and appropriate expansion / anchor load calculations as part of the handover documentation.
Where a grooved system is used, liaise with the system manufacturer and ensure that the complete system (which may incorporate a combination of proprietary expansion devices and standard grooved couplings / fittings) is in accordance with their recommendations.

Unrestrained expansion joints
Axial expansion joints shall only be used in positions where pressure thrust can be contained by adequate anchor points contained by the building fabric. The expansion joint manufacturer shall submit calculations for anchor loadings for onward transmission to the Structural Engineer.

Restrained expansion joints

Restrained expansion joints shall be used as an offset type either by using lateral or angular expansion joints to compensate for thermal expansion or building movement. The expansion joint restraints shall be designed to absorb the full pressure thrust of the expansion joint convolutions.

Lateral expansion joints shall be of the thick wall spirally wound multi-ply construction and fitted with threaded tie bars and low friction self-lubricating hemispherical nuts, allowing movement in two planes.

Angular expansion joints shall be of the thick wall spirally wound multi-ply construction and be used in pairs or threes. All hinge pins shall be PTFE coated to reduce friction and prevent corrosion.

For movement in two planes Gimbal Expansion joints shall be used in pairs or in combination with one Angular Expansion joint. All hinge pins shall be PTFE coated to reduce friction and prevent corrosion.

All expansion joints must be manufactured and supplied by companies complying with the requirements of Lloyds register quality assurance ISO9001. A Certificate of compliance must be issued for approval by the engineer prior to orders being placed.

2631A SLIP TYPE GROOVED END EXPANSION COMPENSATORS:

Material - ductile cast iron to ASTM A536, grade 65-45-12.
Ends - grooved for mechanical joints.
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.
Type - slip-type expansion compensation device, gasketed, with grooved coupling ends and 'telescoping' body.
Size - 50mm to 150mm.
Maximum axial end movement - 76mm.
Limiting test pressure - 24bar pressure rated.
Gasket - grade 'E' EPDM for water services to 110°C.
Installation to be strictly in accordance with the manufacturer's instructions.

2631B GROOVED END MULTIPLE FLEXIBLE COUPLINGS TYPE COMPENSATORS:

Coupling material - ductile cast iron to ASTM A536, grade 65-45-12.
Ends - grooved for mechanical joints.
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.
Type - multiple standard flexible grooved couplings joined by grooved end nipples.
Axial movement - dependent on number of couplings in the compensator, refer to schedule/particular specification.
Gasket - grade 'E' EPDM for water services to 110°C

2651 FLEXIBLE CONNECTIONS AND NOISE AND VIBRATION ABSORBERS

Generally

Flexible connections shall be fitted to all pump suction and discharge connections, chillers condensers and other centrifugal, reciprocating or vibrating plant

Flexible Connections must have certification to demonstrate they have been tested for Noise and Vibration reduction capabilities

Flexible Connections are to be fitted as close to the source of vibration as practicable. The pipework and flexible connections shall be installed to prevent any stresses in the pipework from being transmitted to the pump or vibrating equipment. To ensure correct alignment, a spool piece is to be employed during installation.

Rubber Flexible Connections shall be single convolution of hand laid multi ply reinforced EPDM rubber with wire reinforced cuffs. Flanges shall be removable and suitably profiled to control the convolution shape; plate flanges must not be used under any circumstances.

Threaded and adjustable tie bars with rubber top hat washers shall be used where the working pressure exceeds 1.5 bar.g. When untied flexible connections are used, the manufacturers recommendations for anchors and guides shall be followed to prevent forces being exerted on to the pump casing and AV mounts.

All flexible connections must be manufactured and supplied by companies complying with the requirements of "Lloyds register quality assurance ISO9001". A Certificate of compliance must be issued for approval by the engineer prior to orders being placed.

Comply with the requirements of DIN 4809

Marking

The flexible Connections must be fully traceable: and moulded into the Flexible carcass shall be the manufacturer, country of origin, type and batch number, serial number, easily recognisable colour flashes and the date of manufacture.

Ends

Flanges to BS EN 1092 - 1 that can swivel and are removable; or threaded to relevant parts of BS EN 10226 with one union end to suit pipework as indicated.

Working temperatures up to 70°C

Flexible carcass can be reinforced using high tensile synthetic fibre reinforcement.

Working temperatures between 70°C and 100°C

Flexible carcass must be steel wire mesh reinforced throughout. Connections are to have a minimum design life of 10 years, continuously operating at 100°C and a minimum burst pressure of 30 bar.g, in compliance with the minimum requirements of DIN4809: Part 1.

Working temperatures above 100°C

Flexible Connections must be of thick wall spirally wound multi-ply construction stainless steel, all welded construction with tie rods.

Ends Flanges to BS EN 1092 - 1

2661 FLEXIBLE HOSES (COMPENSATORS) / TERMINAL UNIT CONNECTIONS

Application

Sealed LTHW and chilled water systems only

Standards

Flexible hose assemblies (up to 25mm nominal bore) for use in closed circuit heating and cooling systems shall be manufactured in accordance with BSRIA Guide BG 4/2004

Flexible hoses shall be installed in accordance with BSRIA Code of Practice 11/2002. (Flexible hoses a code of practice for services installers)

Material

EPDM inner liner with stainless steel wire braid. Nickel plated brass fittings with stainless steel ferrules.

Or corrugated metal in accordance with BS EN 14585-1 and PD CEN/TR 14585-3

Operation

Minimum length 300mm.

Ensure hose is capable of resisting kinking when bent through 180 deg.

Working pressure 15 - 20 bar and temperature 110 °C

or as otherwise indicated.

Other features

Supply chilled water connections fully insulated with end caps. The insulation shall form a vapour tight seal on the hose ferrules.
The hoses shall be colour-coded red and blue to indicate its suitability for LTHW and Chilled water.

Chilled water hoses shall be fully insulated and the insulation fitted with end caps.
The hoses shall have been thermal cyclic tested from 6°C to 90°C for at least 5000 cycles, carried out by an independent test authority.
All Hoses shall have a minimum 10 year warranty.

High temperature and critical applications

Where the operating temperature exceeds 100°C, flexible connections shall be constructed from convoluted stainless steel flexible hose, with a stainless steel wire braid, all welded construction.
The hoses shall be of annular corrugated construction and manufactured from AISI 321 Stainless Steel.

The hose shall be braided or unbraided to suit the temperatures and pressures.

Fitting shall be welded or brazed to suit the application. All hoses shall be 100% leak tested by the manufacturer.

The manufacturer shall be consulted to determine minimum flexible length and installation configuration.

All terminal connections must be manufactured and supplied by companies complying with the requirements of Lloyds register quality assurance ISO9001.

2662 FLEXIBLE HOSES FOR DRINKING WATER INSTALLATIONS & HOSES AS INTEGRAL PARTS OF APPLIANCES

Standards

Flexible hose assemblies for drinking water installations to connect sanitary tap ware, heaters and similar appliances operating temperature 70 °C to be in accordance with BS EN 13618.
Flexible hose assemblies intended to be used as integral parts of appliances, to be in accordance with BS EN 61770.

2663 HOSE AND HOSE ASSEMBLIES FOR STEAM AND CONDENSATE

N/A

2670A TEST PLUGS, SELF SEALING:

Provide self-sealing test plugs with integral means of isolation, 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.
Install test plugs:

Either side of each strainer (unless integral with strainer)
Either side of each pump set
On the flow and return connection to each calorifier/heat exchanger/boiler/chiller/condenser
On the flow and return connection to each coil
Across the ports of each control valve
Elsewhere as necessary to allow the system to be commissioned in accordance with the CIBSE Commissioning Codes
Elsewhere as indicated

2671z TEST PLUGS, VALVE CONTROLLED:

On MTHW and HTHW provide 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. Install as 2670A.

2681 PIPELINE STRAINERS:

Ends

To match pipework. Screwed to relevant parts of BS EN 10226 or flanged to BS EN 1092-1 or BS EN 1092 – 2 or BS EN 1092 – 4 or grooved.

Pattern

Simplex basket, Duplex basket or Y pattern as indicated on schematic drawings or as scheduled

Screen free area

Not less than 250% of pipe bore or as indicated.

Screen perforations

15 - 50mm, within range 0.7 - 0.9mm diameter.

65mm and above, within range 1.5 - 1.8mm diameter.

unless otherwise indicated.

Internal to external flow through screen.

Provide plugged connections for drain, air vent and differential pressure monitoring, threaded to BS 21.

At commissioning allow for the installation of temporary fine mesh screens in main system strainers.

2682 PIPELINE SUCTION GUIDE/STRAINERS:

Application – to provide a flow straightener to achieve optimum flow conditions

Body material - cast iron or ductile iron for water services to 110°C

Ends - flanged to PN16 or PN25 to suit system maximum working pressure.

Stainless steel strainer and fine mesh (start-up) strainer.

Unit to be complete with flow stabilising vanes to allow connection direct to pump suction.

Unit to be complete with removable stainless steel fine mesh sleeve start-up pre-filter.

Provide plugged connections for drain, air vent and differential pressure monitoring.

Installation to be strictly in accordance with the manufacturer's instructions.

2690C TUNDISHES:

Provide tundishes for all drains from equipment, located adjacent to equipment, or as indicated, in material to suit piping.

Material

Copper sheet nominally minimum 3mm thick.

or Mild steel galvanized after manufacture.

Construction

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.

2700z GAUGES:

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.

Dial cases

In plant rooms

150mm diameter, heavy pattern, finished in black stove enamel.

In other areas

100mm diameter, finish chrome plated unless otherwise indicated

Use white dial scales indelibly and clearly marked with black lettering to indicate measured valves. Select scale ranges which indicate 'Normal' when pointer is vertical or central on scale.

Mount gauges with dial face in vertical plane and locate as follows

Direct

Support casing by connection to instrument, unless otherwise indicated.

2710z TEMPERATURE GAUGES:

Use temperature gauges with pocket and provided with gland attachment on thermometer stem.

Type

Mercury in steel, mounted direct in pocket.

or Vapour pressure to BS EN 13190, mounted direct in pocket with horizontal or vertical stem as appropriate.

or Vapour pressure to BS EN 13190, for remote mounting with capillary tube of sufficient length to allow slack run to immersion bulb. Protect capillary along full length by a flexible sheath jointed to dial case and bulb.

Use separable type pockets, threaded 15/19mm BSP and manufactured from stainless steel unless otherwise indicated.

Screw pockets into tapped bosses or stools set in pipelines or vessels. Fill pockets with oil 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.

2720 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 Pa 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 pig tail siphons and double isolation valves on steam, MTHW and HTHW systems. Use “U” siphons on all other services.

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.

2730 VACUUM GAUGES:

Use vacuum gauges complying with BS EN 837-1. Calibrate in mm of mercury.

2735 DIFFERENTIAL PRESSURE GAUGES:

Supply where indicated.

2740z GAUGE MOUNTING BOARDS:

Mount on walls or purpose made steel frames at a height approximately 1.3m above floor level as indicated

Manufacture from 12mm thick hardwood, and polish.

or Manufacture from 3mm mild steel plate, finished black stove enamel and trimmed with chromium plated strips approximately 10mm wide.

3000 ACCESSORIES

3010z LOOSE ITEMS:

Provide 5 no. tee handled short shank keys suitable for each size of valve spindle shank.

Provide one lever pattern key suitable for each drain cock.

Provide loose hose unions each for drain cock.

3020z VALVE SEAT REPLACEMENT

Provide a seat replacement tool for the TRV's, where fitted.

4000 WORKMANSHIP APPROVAL

Ensure all valves used on potable services have WRAS approval, and are so marked.

4010 INSTALLATION:

Install pipeline ancillaries in accordance with manufacturer's recommendations and BS 6683.

4021 LOCATION OF VALVES AND ANCILLARIES:

Install valves, cocks, traps, strainers, test plugs, tundishes and other ancillary equipment in positions indicated and as a minimum as follows:

Mains to isolate major sections of distribution.
The base of all risers and drops except in cases where one item of apparatus only is served which has its own local valve or stop tap.
Points of pipe connection of all items of apparatus and equipment except where the item could conveniently be isolated or regulated by valves provided for other adjacent items.
At all terminal units. (For hot and cold water services incorporate a flow regulator within the fitting isolation valve where the static pressure exceeds 1 bar).
Draw-off fittings except where ranges of fittings are served by a common float, the isolator then being fitted with the float.
At all sanitary fittings.
At all main branch connections

Locate drain valves at all low points

4025 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.

4030 POSITIONING OF COMPONENTS:

Locate flow and pressure measurement and control valves to ensure manufacturer's recommended straight length of pipe upstream and downstream of valve is provided.

4040 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 or in accordance with the manufacturers recommendations. .

4041 POSITIONING OF MEASURING STATION/COMMISSIONING SETS:

Install station to ensure equivalent of 10 diameters of straight pipe upstream of metering station and 5 diameters downstream of double regulating valve or in accordance with the manufacturers recommendations. .

4050 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 for approval of method proposed to insulate component.

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.

4060 VENT COCKS:

Provide outlets of vent cocks with discharge pipes terminated in a safe, visible & accessible location.

4070 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.

4080z DISCHARGE CONNECTIONS:

Fit pipework connections, where indicated, to

Provide

Discharge connection to Safety and Relief valves terminating at a safe discharge point.

Discharge connection to vent cocks terminating 150mm above floor level.

Bleed connection from air bottles terminating with air cock or needle valve in a convenient position.

Discharge pipe to automatic air vents terminating over a suitable gully or drain line in a visible location.

4090 EXPANSION DEVICES:

Arrange supports and fixings to accommodate pipe movement caused by the thermal changes, generally allow the flexure at changes in direction. Allow for movement at branch connections.

On drainage pipework use purpose designed fittings at changes of direction to accommodate movement, and to avoid stresses on connections to stacks.

Where possible provision for movement due to thermal expansion and contraction shall be made by natural changes in the direction of pipework.

Anchors and guides shall be positioned to contain all movement and resist the maximum loads imposed.

Anchors and guides are to be located at points which prevent excess stresses on pipework, joints and equipment connections. Similar provisions shall be made for building movement or building settlement.

Any provisions for expansion, anchors and guides shown on the drawings are for guidance, the actual requirements shall be determined by the Contractor.

The contractor shall utilize one of the named specialists and confirm in their tender submission that all provisions for pipework expansion have been included.

All loads on the building structure shall be advised to the Structural Engineer prior to the installation commencing.

4100 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.

Select and install metallic bellows expansion joints, test/inspect the systems after installation of the expansion joints and 1st full movement and provide certification in accordance with BS 6129-1.

4110 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.

4120 TERMINAL UNIT CONNECTIONS INSTALLATION:

Install hose connections strictly in accordance with manufacturer's instructions.

4132 GAUGE MOUNTING LOCATIONS:

Mount gauges in the following locations:-

: Primary heating and cooling source - inlet and outlet pipeline temperature gauges.

: Pipelines leaving and entering plantrooms - temperature gauges.

: Main system pipeline headers - temperature gauge.

: Heat exchangers - primary and secondary pipelines inlet and outlet temperature gauges.
: Air handling plant - supply air temperature gauge.
: Pumps - suction and discharge connections pressure gauges mounted on a gauge board.
: Plant items - specified sensing points.
: Packaged plant, control panel mounted, gauges as specified.
: Elsewhere as indicated on the drawings.

10000 Based on NES TEXT May 19

1010 PUMPS:

Provide pumps manufactured and tested in accordance with appropriate British Standard as defined in clause 2201. Comply with safety requirements as BS EN 809, and BS EN 60335-2-51 where applicable.

1015 POTABLE WATER SERVICE PUMPS:

To be WRAS approved.

1020 PUMP SELECTION AND EFFICIENCY:

Select pump at or near most efficient part of performance curve for duty required.

Centrifugal glanded pumps

Comply with EU Regulation 547/2012 on Eco Design requirements of glanded centrifugal water pumps.

Do not select pumps on flat part of performance curve.

Pump efficiency

Pump efficiency tests shall be carried out in accordance with BS EN 16480.

Determine Energy Efficiency Index (EEI) in accordance with BS EN 17038-1 and BS EN 17038-2

Whenever possible select single stage glanded centrifugal pumps to achieve minimum pump efficiency (after correcting for pump head) equal to or better than defined by the upper efficiency line in figs 3 – 6 of the "European Guide to Pump Efficiency for Single Stage Centrifugal Pumps" as published by Europump 2003. (ie "Optimum efficiency selections). Pumps with a corrected efficiency between the upper and lower efficiency lines in this guide (ie efficient selections) will only be considered if it can be shown that an "Optimum efficiency" pump is not available.

Limiting Efficiency Index (MEI) to be as scheduled.

Motor / drive – Provide packaged pumps with motor and VSD integrated as part of the package unless scheduled otherwise.

Glandless Circulators.

Comply with EC Regulation 641/2009 and the amendment EU Regulation 622/2012 for glandless circulators.

Pump efficiency

Comply with BS EN 16297-1 and BS EN 16297-2 for general requirements and procedures for testing and calculation of the Energy Efficiency Index (EEI) for stand-alone circulators.

Comply with BS EN 16297-1 and BS EN 16297-3 for general requirements and procedures for testing and calculation of the Energy Efficiency Index (EEI) for circulators integrated into products.

Include EEI of pump on name plate together with an indication of which part of BS EN 16297 was applied for the determination of the EEI.

Limiting Energy Efficiency Index (EEI) to be as scheduled.

Motor - Provide electronically controlled permanent magnet type or EC motor.

1022 DESIGN DUTIES:

Pump Volume: Ensure scheduled volume is provided when operating against resistance of system corrected for changes between specified and selected component resistances.

Quoted pump duties are based on component pressure losses as scheduled in Y20sch. Adjust scheduled pump resistances to compensate for actual resistance of selected components.

Adjust pump heads if changes are made to pipework routing or arrangement in preparation of installation drawings or details.

Commissioning Allowance: Quoted pump duties include the following commissioning allowances:

Flow Rate	10%
Head	15%

These allowances are on top of the calculated design duty to allow for system regulation and additional fittings, unforeseen at the design stage and are not intended as "future spare capacity".

Pump Speed: Refer to schedule for maximum pump operating speed.

1024 BELT DRIVEN PUMPS

N/A

1025 DIRECT DRIVE PUMPS

For each direct driven pump (both single pumps and twin headed pumps) without inverter or other speed control, allow for a change of impeller (to be sized after balancing the system). Allow for changing impeller and recommissioning pump and then rechecking system as necessary to achieve the specified duty.

All inline direct drive pumps for floor mounting shall be supplied with a proprietary support foot.

1026 TWIN HEADED CENTRIFUGAL PUMPS

Pumps shall be selected as duty and standby. All twin headed pumps shall be supplied with a matching blanking plate to enable the pump to be operated with a single head fitted during maintenance or replacement of standby head / impeller.

All pumps for floor mounting shall be supplied with proprietary support foot.

1030 SAFETY GUARDS:

Fit safety guards around revolving parts on close coupled and belt drive pumps.

1040 PUMP TESTING:

Hydraulic performance tests at manufacturer's test facilities

Ensure pumps comply with BS EN ISO 9906 or BS EN ISO 5198 where an extremely high accuracy of measurement is required.

Comply with reference section Y92 clauses for motors.

Ensure all pumps do not have any distinguishable, discrete continuous noise or give rise to distinct impulses.

Noise testing

When specified in the scope of works or schedules, undertake noise measurements in accordance with BS EN ISO 20361.

Glandless circulators having a rated input of up to 200W to be tested in accordance with BS EN 16644 for structure and fluid borne noise.

1045 PUMP MOTORS / STARTERS:

Refer to Controls / Monitoring section W60 and Y20 schedule for detailed requirements.

Comply with reference section Y72 clauses for starters.

Comply with reference section Y92 clauses for motors.

Variable speed drives specified as integrated with the pump shall be isolated from any vibration from the pump / motor and have a life expectancy no shorter than the motor life expectancy. Facility to connect to a BMS shall be incorporated into drives supplied by the pump manufacturer.

2000 PRODUCTS/MATERIALS

2011 CASING:

Provide casing with drain connection fitted with plug.

Provide threaded connections in accordance with BS EN 10226 for drains, vents, water jackets, cooling lines, etc.

Provide pump with split casing to allow access to the impeller for service and maintenance.

2015 VARIABLE FLOW CONTROL:

For variable volume systems, pumps shall be selected with a steep curve in the anticipated range of the system. This will ensure that a significant change in differential pressure occurs at the sensor as the flow varies, resulting in a significant change in pump speed and subsequent energy saving. Do not select pumps with flat curves; this will cause the pressure at the pump to stay roughly the same as the system resistance changes.

Where variable speed drives are fitted to direct drive pumps, ensure the drive meets the safety requirements of BS EN 61800-5-1.

Also comply with Y72 clauses for details of variable speed drives.

2016 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.

2017 SHAFTS:

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.

2018 BEARINGS

Grease Points (where specified)

Provide bearings with lubrication line extended to grease nipple at convenient position with protection against over filling.

2019 SUCTION AND DELIVERY CONNECTIONS:

Flanged to BS EN 1092-2 or screwed to BS EN 10226 to match pipework.

2201 PUMPS (MATERIALS)

Type		A	C	E	E 1	G
Description		Centrifugal	Centrifugal	Centrifugal	Centrifugal	Centrifugal Multistage
Configuration		Motor mounted vertically above casing on a common bedplate (belt driven)	Pump casing and motor mounted on a bedplate in line (close coupled)	Direct driven unit with pump body incorporating inlet and outlet connections in line, to allow pump to be mounted in pipework or floor mounted	Direct driven twin head unit with pump body incorporating inlet and outlet connections in line, to allow pump to be mounted in pipework or floor mounted	Motor mounted vertically above casing on a common pedestal (close coupled)
Pump Standards		BS EN ISO 9908 BS EN ISO 3661 BS EN 12756 BS EN 733	BS EN ISO 9908 BS EN ISO 3661 BS EN 12756 BS EN 733	BS EN ISO 9908 BS EN 12756 BS EN 733	BS EN ISO 9908 BS EN 12756 BS EN 733	BS EN ISO 9908 BS EN 12756
Material	**Casing**	Cast Iron to BS EN 1561	Cast iron to BS EN 1562	Cast iron to BS EN 1561	Cast iron to BS EN 1561	Cast iron to BS EN 1561
	Impeller	Gunmetal to BS EN 1982	Cast iron to BS EN 1562	Cast iron to BS EN 1561	Cast iron to BS EN 1561	Cast iron to BS EN 1561
	Shaft	Stainless steel to BS EN 10088	Stainless steel to BS EN 10088	Stainless steel to BS EN 10088	Stainless steel to BS EN 10088	Stainless steel to BS EN 10088
Bearings		Ball Sealed-for-life	Sleeve	Ball Sealed-for-life	Ball Sealed-for-life	Sleeve
Glands		Mechanical	Mechanical	Mechanical	Mechanical	Mechanical
Seal Housing		Cast Iron to BS EN 1561	Cast iron to BS EN1452	Cast iron to BS EN 1561	Cast iron to BS EN 1561	Cast iron to BS EN 1561
Drive		Belt	Close coupled	Direct coupled	Direct coupled	Direct coupled

Type	G1	I	I1	I2
Description	Centrifugal	Centrifugal	Centrifugal	Centrifugal
Configuration	Motor mounted vertically above casing on a common pedestal (close coupled)	Sealed unit with immersed rotor with pump body incorporating inlet and outlet connections in line, to allow pump to be mounted in pipework	Sealed unit with immersed rotor with pump body incorporating inlet and outlet connections in line, to allow pump to be mounted in pipework	Sealed unit with immersed rotor with pump body incorporating inlet and outlet connections in line, to allow pump to be mounted in pipework

Pump Standards		BS EN 12756	BS EN 16297 Parts 1&2	BS EN 16297 Parts 1&2	BS EN 16297 Parts 1&2
Material	**Casing**	Cast iron to BS EN 1561 Stainless steel to BS 1449 Part 2	Cast gunmetal to BS EN 1982	Cast iron to BS EN 1561	Cast iron to BS EN 1561
	Impeller	Stainless steel to , BS EN 10088	Stainless steel to , BS EN 10088	Noryl	Noryl
	Shaft	Stainless steel to BS EN 10088	Ceramic	Stainless steel to BS EN 10088	Stainless steel to BS EN 10088
Bearings		Sleeve	Pre-packed type requiring no maintenance (in-line pumps)	Sleeve	Sleeve
Glands		Mechanical			
Seal Housing		Cast iron to BS EN 1561	Gunmetal to BS EN 1982	Cast iron to BS EN 1561	Gunmetal to BS EN 1982
Drive		Direct coupled	Direct coupled	Direct coupled	Direct coupled

Type		I3	K1	K	M
Description		Centrifugal	Centrifugal	Centrifugal	Centrifugal
Configuration		Sealed unit with immersed rotor with pump body incorporating inlet and outlet connections in line, to allow pump to be mounted in pipework	Pump casing and motor in line (close coupled) sealed vertical assembly	Pump casing and motor in line (close coupled) sealed vertical assembly	Motor mounted vertically above casing on a common pedestal (close coupled)
Pump Standards		BS EN 16297 Parts 1&2	BS EN ISO 9908 BS EN 12756	BS EN ISO 9908 BS EN 12756	BS EN ISO 9908 BS EN 12756
Material	**Casing**	Cast iron to BS EN 1561	Stainless steel to and BS EN 10088	Cast iron to BS EN 1561or Cast gunmetal to BS EN 1982 or Cast steel to BS EN 10213 or SG iron to BS EN 1563 or Stainless steel to BS EN 10088	Cast iron to BS EN 1561
	Impeller	Stainless steel to and BS EN 10088	Stainless steel to BS EN 10088	Cast iron to BS 1452 or Gunmetal to BS 1400 or Stainless steel to BS EN 10088 or Ni-resist to BS EN 13835	Maranyl
	Shaft	Stainless steel to BS EN 10088	Stainless steel to BS EN 10088	Stainless steel to BS EN 10088 or high tensile carbon steel	Stainless steel to BS EN 10088
Bearings		Pre-packed type requiring no maintenance (in-line pumps)	Sleeve or Ball or Sealed-for-life or Spherical roller or Pre-packed type requiring no maintenance (in-line pumps) or Water lubricated (sealed unit in-line pump) or grease point	Sleeve or Ball or Sealed-for-life or Spherical roller or Pre-packed type requiring no maintenance (in-line pumps) or Water lubricated (sealed unit in-line pump) or grease point	Sleeve
Glands			Mechanical	Mechanical	Mechanical
Seal Housing		Cast iron to BS EN 1561		Cast iron to BS EN 1561 Gunmetal to BS EN 1982	
Drive		Direct coupled	Direct coupled	Direct coupled or Close coupled	Direct coupled

Type		S	S1	V
Description		Positive displacement	Positive displacement	Positive displacement
Pattern		Helical	Helical	Rotary
Material	**Casing**	Cast iron to BS EN 1561 or SG iron to BS EN 1563 and BS EN 1564	Cast iron to BS 1452 or SG iron to BS EN 1563	Cast iron to BS EN 1561
	Impeller			
	Shaft			High tensile carbon steel
Bearings		Spherical roller	Sleeve or Ball or Sealed-for-life or Spherical roller or Pre-packed type requiring no maintenance (in-line pumps) or Water lubricated (sealed unit in-line pump) or Grease point	Sleeve
Glands		Mechanical	Mechanical	Packed
Seal Housing		Cast iron to BS EN 1561	Cast iron to BS EN 1561	Cast iron to BS EN 1561
Drive		Direct coupled	Direct coupled	Direct coupled

3000 ACCESSORIES

3010 DRIVE BELTS:
N/A

3020z MATCHING FLANGES:
Provide flanged pumps with matching flanges to relevant part of BS EN 1092, pressure/temperature to match pipework.

3031 DRAIN LINES FROM PACKED AND WATER-COOLED GLANDS:
N/A

4000 WORKMANSHIP

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. Do not install glandless pumps with the shaft in the vertical.

4020z PIPELINE CONNECTIONS:
On other than small in-line circulators, support pumps independently from connecting pipework to ensure no load is transmitted from pipework to pump casing on pump suction and discharge.

4030z MOUNTINGS:
Mount motors and pumps for belt drive pumps resiliently. Comply with reference section Y52 clauses.

4050 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.

4060 ACCESS:
Locate pump within the system with adequate space around it for service and maintenance.

4070 MAINTENANCE REQUIREMENTS FOR SEWAGE PUMPS:

For ease of service and maintenance, install submersible sewage pumps on guide rails or with lifting cables. Fit pumps with automatic discharge connections, which
Locate on to permanent pipework at low level in chamber.

10000 BASED ON NES Y20TEXT Dec 19

Y21 – Water Tanks/ Cisterns

1011 TANK DESIGN:

Design and fabricate tanks/cisterns in accordance with British Standards and HSE requirements including but not limited to BS EN 806 parts 1-5, BS 8558 and HSG 274 Part2.
All split storage tanks shall be configured such that either section can be used while the other is being maintained.
On healthcare projects comply with HTM 04-01: Safe water in healthcare premises.

1021 STORAGE WATER CISTERNS

Cisterns supplying water for domestic purposes (i.e. water supplied for drinking, washing, cooking and sanitary purposes) shall comply in all respects with relevant regulations:
England and Wales - The Water Supply (Water Fittings) Regulations 1999, the Water Act 2014 and the Construction Products Regulations 2013.
Scotland - The Water Supply (Water Fittings) Byelaws 2014.
Northern Ireland - The Water Supply (Water Fittings) Regulations (Northern Ireland) 2009.
All cisterns / tanks shall be provided with a drain valve (50mm dia minimum) at their lowest point.

1022 DEFINITIONS:

Cistern:	An open top rectangular vessel.
Tank:	An open or closed top rectangular vessel as defined in particular BS.
Water line:	Highest level of water at which a cistern or open top tank is designed to work.
Capacity:	Capacity of an open topped vessel when filled to water line. Capacity of a closed top vessel when filled to top of vessel.
Working Pressure:	Static head represented by maximum depth of tank or cistern. For closed tanks, vertical distance from bottom of tank to water level of cistern feeding it.

2000 PRODUCTS/MATERIALS

2005 CONNECTIONS

Outlet connections shall be at the opposite ends to inlets and in large cisterns and tanks, diagonally offset.

2011 SECTIONAL STEEL TANKS:

N/A

2021 GLASS REINFORCED PLASTICS SECTIONAL TANK TO BS EN 13280 CLASS A1 OR A2:

Class A1 or A2 for potable water.

Plate Flanges	-	External
Tank Top	-	Closed
Manhole	-	as indicated
Divisions	-	as indicated
Erection	-	by supplier
Ladder	-	Standard -BS 4211
Supports	-	Provide transverse supporting bearers
Materials	-	As BS EN 13121-1.

2022 GLASS REINFORCED PLASTICS SECTIONAL TANK TO BS EN 13280 CLASS B:

class B for non-potable water.

Plate flanges	-	External
Tank Top	-	Closed
Manhole	-	as indicated
Divisions	-	as indicated
Erection	-	by supplier
Ladder	-	Standard BS 4211
Supports	-	Provide transverse supporting bearers.

Materials - As BS EN 13121-1.

2041 PREFABRICATED STEEL CISTERNS:
N/A

2051 MOULDED PLASTIC CISTERNS:
Standard
BS 4213. (up to 500 litre)

2061 GLASS REINFORCED PLASTICS CISTERNS:
Standard
BS EN 13280 (500litre to 100,000litre)
Materials
As BS EN 13121-1.

3021 TANK ANCILLARIES
Detailed project specific requirements as scheduled or indicated on the drawings.
Manholes, to be provided over ball valve locations with separate manhole for access into tank.
Contents gauges to be Hydro Static type ("cat and mouse" type indicators shall not be used due to their tendency to encourage algai growth).
Float type high and low level alarms and necessary boss connections
Access ladders to BS 4211. (Internal to be stainless steel or GRP, external to be galvanised steel).
Temperature probes to be positioned 300mm below top layer level and 300mm above bottom of tank.

4000 WORKMANSHIP

4010 GENERAL:
Store, handle and erect all in accordance with manufacturer's recommendations, relevant British Standards and The Water Supply (Water Fittings) regulations 1999.
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.

4040 INSTALL MOULDED PLASTIC CISTERNS:
In accordance with Appendix R of BS 4213.

4051 INSTALL SECTIONAL STEEL TANKS:
In accordance with manufacturer's recommendations.

4061 INSTALL GLASS REINFORCED PLASTICS CISTERNS:
In accordance with instructions in BS EN 13280.

10000 NES
Based on Y21TEXT Sept 18

1005 DEFINITION

The materials, apparatus and methods detailed throughout the ductwork component schedules and specification clauses apply to all enclosures for conveying air, and their ancillaries, whether as ducting runs or casings for equipment and accessories.

1007 DESIGN

Ensure that the design velocities and pressure conditions comply with the values and tests specified.

1010 DUCTWORK AND ANCILLARIES INSTALLATION STANDARDS:

Carry out construction and installation of ductwork in accordance with BESA DW/144, DW/145, DW/154, DW/172 and DW/191 and BS 9999 as appropriate / scheduled.

Comply with BS EN 1507, BS EN 12237, and BS EN 13403 (Ductwork made from insulation ductboards) as appropriate / scheduled.

Where builders work ducts are used they shall be thoroughly cleaned and sealed prior to plant operation.

Where ducts penetrate a floor separating habitable rooms in different flats within residential buildings they shall be enclosed for their full height and full horizontal run in each flat and surrounded with sound absorbent material above and below the floor. The installation shall comply with the requirements of Approved Document E of the Building regulations. “Resistance to the passage of sound”.

Install and inspect fire resisting duct systems in accordance with Building Regulations and ASFP Code of Practice TGD 18.

1021 DUCTWORK DIMENSIONS:

Sizes of ductwork are internal airway dimensions. Where applicable make allowance for any internal lining.

1022 DUCTWORK LAYOUT

Set out ductwork as indicated on the drawings, making due allowance for any diagrammatic presentation.

Provide all necessary offsets, bends, tapers, transformation pieces etc. required whether or not these are detailed. Make due allowance for any thermal movement on long runs.

1031 ELECTRICAL BONDING TERMINAL:

Ensure an electrical bonding terminal suitable for connection of 6mm^2 maximum conductor is provided where required by BS 7671 Requirements for Electrical Installations clause 544.1

1041 INSTALLER SELECTION: (NES 230.020)

Use a member of the BESA (Building Engineering Services Association) specialising in manufacturing and installing ductwork.

Where post installation cleaning is specified, appoint a specialist cleaning contractor to undertake the work in accordance with BESA TR/19, and supply and install any additional cleaning openings to suit their selected specific methods of cleaning and to suit the practical site conditions relative to the fabric of the building and position of other services.

For existing systems that require inspection and cleaning prior to modification or re-commissioning (including kitchen extract systems):

Use a specialist, approved in accordance with Loss Prevention Standard LPS 2084, to undertake the following:

- Inspect and clean ductwork that may be contaminated with combustible deposits.
- Make recommendations for access improvements to any areas where there is currently limited access making cleaning / maintenance impractical.

2000 DUCTWORK FABRICATION/MATERIALS

2011 DESIGN INFORMATION:

General

All ductwork and associated materials shall be manufactured, installed and tested, in accordance with the current editions of BESA Specification DW/144 and DW/154 for sheet metal ductwork and plastic ductwork respectively, for low, medium and high pressure/velocity air systems, and as qualified in this specification.

Ductwork Classification

Ductwork to be used on this project shall be as scheduled.

The ductwork pressure classifications scheduled are in accordance with the limits for positive/negative static pressure, air velocity and air leakage defined in table 1 in DW144.

Fabricate ductwork to meet pressure classification in accordance with DW/144 Table 1 and DW/154 table 1. Fabricate ductwork to meet leakage classification in accordance with DW/144 Table 1 and DW/154 table 1. Where indicated ensure ductwork is suitable for a variable air volume system.

For special installations where contaminants are indicated, ensure materials and construction of ductwork are suitable for contaminants in the airstream.

2024 DUCTWORK AIR LEAKAGE TESTING - GENERAL:

Carry out ductwork air leakage testing on those sections of systems with a design flow rate greater than $1m^3/s$ where the pressure class is such that DW/143 recommends testing and where the BER calculation assumes a leakage rate lower than the standard in DW/144.

Test to be in accordance with the requirements of the latest version of Building Regulations ADL2 A&B and DW/144 or appendix A in DW/154 as appropriate and as procedures set out in DW/143. Use portable fan and test equipment and apply to erected sections of the ductwork complete with access doors at the test pressure and flow rates as scheduled.

Test before insulation is applied to ductwork.

Achieve leakage rates indicated or better.

Test ductwork components with the ductwork, where they are able to withstand the test pressure, otherwise isolate.

If the test fails, pressure test four further sections. If the further tests fail apply remedial action to the complete ductwork system.

The results to be recorded on test sheets based on DW/44 or DW/154 and DW/143 examples and compared to acceptable leakage rate specified or better.

Sections, which need unacceptable levels of remedial work on seams or joints, shall be replaced by new sections. This requirement shall be identified during the preliminary test to DW 143.

Provide documented evidence of the calculations used to arrive at the allowable loss for the section to be tested and ensure the client or their representative witness and sign the results of the tests.

All "in duct" plant shall be factory tested to the same leakage classification by the Manufacturer.

Builders work ducts used as part of a ductwork supply system shall be sealed in accordance with the Architect's specification by the Contractor. The ducts / shafts shall be leakage tested to demonstrate that leakage is no greater than the requirements for sheet metal ductwork class A as defined in DW/143 at the design pressure at that part of the system.

For pressure and leakage testing - builder's work shafts, voids, enclosures and floor voids / plenums refer to clause Y51 2015.

2025z SPARK TESTING ON PLASTICS DUCTWORK:

N/A

2031A HIGH PRESSURE DUCTWORK AIR LEAKAGE TESTING:

N/A

2031B MEDIUM PRESSURE DUCTWORK AIR LEAKAGE TESTING:

Test medium pressure ductwork in accordance with DW 144 and DW143.

N/A

2031C LOW PRESSURE DUCTWORK AIR LEAKAGE TESTING:

Test low-pressure ductwork in accordance with DW 144 and DW143 as scheduled.

Test the specified proportion of sections of duct system for air leakage. Test at the pressure recommended in DW144 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 on a section fails, pressure test two further sections (to be selected by the Designer). 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 their agent witnesses and signs the results of the tests.

Testing of plant items as DW 144,

2035 STRENGTH AND LEAKAGE TESTING OF CIRCULAR SHEET METAL DUCTWORK:

Where scheduled 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

Where scheduled complete systems shall be leakage tested. Tests shall be carried out when the fan has been first set to work and a visual/audible inspection has been made of all connections from plant to ductwork. This shall include any untested joints between tested sections and all joints and seams not previously subjected to leakage pressure tests, including plant casings, grille joints, dampers etc.

Carry out ductwork strength and air leakage testing on rectangular sheet metal ductwork in accordance with BS EN 1507

2041 DUCTWORK MATERIALS STEEL

Ductwork shall be zinc-coated steel to DW144 Part 2 unless otherwise specified. Where scheduled, external ductwork to be hot-dip galvanized to BS EN 10346

2061A STEEL DUCTWORK TO DW 144 - RECTANGULAR:

Duct

Comply with DW 144 Part 3 for construction of rectangular ductwork.

Additional requirements

Any duct with an aspect ratio greater than 4:1 shall be supplied complete with a central splitter.

Longitudinal seams: Fig Nos. 5, 6 and 7 shall be avoided. Fig No 8 may be used on large duct components with the Designer's approval.

For all side-on flange systems (mezz etc) with bolted corners, joints on all systems shall be further secured with intermediate fastenings to the manufacturer's recommendation.

Full girth stiffeners shall be used in all instances.

Dimpling is not acceptable as a method of fastening.

Plant connection shall be constructed at Tables 2, 3 and 4, but one gauge thicker. Tie bars shall be provided on all plant connections with a side longer than 1500mm.

Turning vanes shall be fitted on square bends. Square branches shall not be used.

Cross-joints

Use cross-joints in accordance with DW 144 or use cross-joints tested in accordance with DW/TM1, unless otherwise indicated.

Finish

Zinc coated steel - hot dip galvanised, or Zinc coated steel - electroplated, or pre-coated steel in accordance with DW 144

2061B STEEL DUCTWORK TO DW 144 - CIRCULAR:

Duct

Comply with DW 144 Part 4 for construction of circular ductwork. Use spirally wound ducts unless otherwise indicated.

Additional requirements

Fig Nos. 34 and 41 in DW 144 will only be acceptable as a means of jointing provided the manufacturers of the proprietary system inspect a minimum of 25% of the joints after installation to verify the installation has been carried out in accordance with their instructions and size limitations.

Components

Square branches shall not be used. On high and medium pressure systems use only conical branches

Fittings

Comply with DW 144 Part 4 for manufacture of fittings for circular ductwork.

Cross-joints

Use cross-joints in accordance with DW 144 or use cross-joints tested in accordance with DW/TM1, unless otherwise indicated.

Finish

Zinc coated steel - hot dip galvanised, or Zinc coated steel - electroplated, or pre-coated steel in accordance with DW 144 Appendix H unless otherwise indicated.

2061C STEEL DUCTWORK TO DW 144 - FLAT OVAL:

Duct

Comply with DW 144 Part 5 for construction of flat oval ducts. Use spirally wound ducts unless otherwise indicated.

Cross Joint

Submit for approval details of any cross-joints not in accordance with DW

Components

Square branches shall not be used; on low-pressure systems use shoe branches in lieu. On high and medium pressure systems use only conical branches.

Fittings

Comply with DW 144 Part 5 for manufacture of fittings for flat oval ductwork.

Finish

Zinc coated steel - hot dip galvanised, or Zinc coated steel - electroplated, or pre-coated steel in accordance with DW 144 unless otherwise indicated.

2062 HIGH PRESSURE SHEET METAL DUCTWORK

N/A

2065 KITCHEN EXTRACT SYSTEMS

N/A

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2071 MAN ACCESS AND SAFETY BARS:

Where man access is provided, ensure that duct floor is of sufficient strength to comply with safety standards. Provide safety bars at the top of all risers unless alternative means of protection are provided.

2072 FLANGED CONNECTIONS:

Provide bolted flanged joints for connecting ductwork to flanged items of plant, builder's work frames and where removable sections of ductwork are required.

2074 PLANT CONNECTIONS:

Make connection between air handling assembly and ductwork system in accordance with DW 144 and manufacturers recommendations.

2101 PLASTICS DUCTWORK TO DW 154:

Manufacture and install plastic ductwork in accordance with DW 154.

N/A

2102 NON-METALLIC DUCTWORK TO BS EN 17192:

N/A

2110A FIRE PROTECTION WITH FIRE DAMPERS:

Method of protection where ventilation ducts pass through fire-separating elements
BS 9999 Method 1 and Method 4 protection using fire dampers and / or automatically actuated fire and smoke dampers triggered by smoke detectors.
Installation to comply with:
BESA DW / 144 and DW/145
Building Regulations Approved Document B
BS EN 15650 – Ventilation for buildings. Fire dampers
Relevant parts of BS EN 1366, BS EN 13501 and BS EN 12101

2110B FIRE PROTECTION WITH FIRE RESISTING ENCLOSURES:

Method of protection where ventilation ducts pass through fore-separating elements -

BS 9999 Method 2 using fire resisting enclosures.

Installation to comply with:

BESA DW / 144

Building Regulations Approved Document B

Relevant parts of BS EN 1366, BS EN 13501 and BS EN 12101

2110C FIRE RESISTING AND SMOKE AND HEAT CONTROL DUCTWORK GENERALLY:

N/A

2110D FIRE RESISTING AND SMOKE AND HEAT CONTROL DUCTWORK WITH FIRE PROTECTION CLADDING:

N/A

2110F FIRE RESISTING AND SMOKE AND HEAT CONTROL DUCTWORK – FACTORY APPLIED FIRE RESISTING FINISH

N/A

2120 INTERNAL THERMAL/ACOUSTIC LININGS:

N/A

2121 EXTERNAL THERMAL/ACOUSTIC INSULATION:

Install required layers of acoustic Insulation, as detailed below, where indicated. (Unless described otherwise in the particular specification)
Material
Duct wrap lamellae glass or mineral wool acoustic insulation.
Polymeric mass layer - 10 kg/m^2
Acoustic performance - Minimum Sound Reduction Index (SRI) – as indicated in particular specification.
Standards: Tested to BS EN ISO 717-1, and relevant parts of BS EN ISO 10140.
Insulation thickness - 50mm
Insulation thermal conductivity - 0.033 – 0.039W/mK at mean temperature of 10°C
Fire resistance - Class 0 Building Regulations when tested to BS 476-6 and BS 476-7
Finish - Reinforced aluminium foil (outer)

Continuous quilted mineral fibre mat .The polymeric mass layer should be positioned outermost from the sound source and overlapped at all joints. The product must be designed to maintain its original thickness subsequent to installation. The lagging should be cut 25mm oversize and a 25mm strip of the inner resilient element removed to create an overlap. The mass layer must not come in contact with the duct.
Overlap and seal all joints with adhesive and external reinforcing tape.
Overlap and seal all joints with adhesive and suitable external reinforcing tape.
Installation -To manufacturer's standard.

2122 ACOUSTIC PLENUMS:
N/A

2130A PRE-INSULATED THERMAL DUCTWORK (NES 2100M/2130#)
N/A

2141 HANGERS AND SUPPORTS:
Provide hangers and supports throughout in accordance with DW 144; DW 154 Part 5 or DW 191, Section 7 as appropriate. See also clause 4021 for hangers and supports workmanship.
Comply with BS EN 12236.
If a proprietary suspension system is provided it shall comprise channel sections with return lips and compatible fixing accessories made of material to BS EN 10162, BS EN 10210.
Ensure all steel components such as studding, bolts and steel screws, bolts, nuts and washers are either cadmium plated and passivated or zinc electroplated to BS 7371 after manufacture. Do not use metal fixing components likely to deteriorate and/or cause damage
Where a wire rope suspension system is used an alternative to drop rods or studding comply with the following standards:
BS EN 12385-1.
BS EN 13411-3.
BS EN 13411-4.
BSRIA COP 22/2002

2151 SUPPORT OF AIR TERMINAL UNITS:
Support air terminal units and their plenums independently of the ceiling grids, unless otherwise indicated. Hangers shall be adjustable.

3000 ACCESSORIES AND COMPONENTS

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.

3021 ACCESS/INSPECTION OPENINGS:
Provide access openings for inspection/servicing in accordance with DW/144, DW 154 Part 6, section 15 and appendix D table 14 or DW 191 Section 8 as appropriate, and:
Adjacent to all fans
Adjacent to all dampers
As necessary for cleaning purposes
See also clause 3051.

3031 TEST HOLES
Provide test holes in ductwork systems to allow complete testing and balancing of each system in accordance with CIBSE Commissioning Code Series A and BSRIA AG3/89.3:2001. Drill test holes on site in accordance with DW/144.
Provide test holes on each side of all equipment in the system, at least 1.5 duct diameters upstream of all dampers and elsewhere as indicated/specified. Seal all test holes with blind grommets.
Provide at each location the number of test holes shown below:

Circular duct

Duct diam (mm)	No of test holes
Up to 150	1
151 to 450	2
Over 450	4

Rectangular/flat oval ducts

Longest side (mm)	No of test holes
Up to 200	1
201 to 400	2
401 to 600	3
601 to 800	4
801 to 1000	5
1001 to 1200	6
1201 to 1500	7
Over 1500	One per 250mm

3041 HOLES FOR CONTROLS/INSTRUMENTS:

Provide suitably sized and positioned holes in ductwork, in accordance with DW/144 or DW 154 to accommodate all necessary thermostats, humidistats and other control. Holes to be bossed and screwed or drilled as appropriate. Where holes are provided on insulated ductwork, extend to finish flush with insulation.

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.

3051 CLEANING ACCESS

Provide access openings for cleaning in accordance with DW/144, TR/19 or DW/154 appendix D as appropriate. In addition, provide access openings such that no point is greater than 5m from an opening. Provide access openings at the top and bottom of every riser.

Refer to BSRIA TN 18/92 for minimum dimensions of access doors.

See also clause 4091.

Where Advanced level of PDI with post installation clean is specified, the specialist cleaning contractor, in addition to taking advantage of openings fitted by the ductwork installer, shall supply and install any additional cleaning openings to suit their selected specific methods of cleaning and suit the practical site conditions relative to the fabric of the building and position of other services.

The specialist cleaning contractor shall select and propose for approval the most appropriate cleaning method from table 8 in TR/19 (section 6.11).

3055 ACCESS/INSPECTION/CLEANING OPENING COVERS

Provide purpose made covers to all access and inspection and cleaning openings. Fit covers with quick release catches. Provide restraining straps. Provide full-face soft neoprene gasket secured to ductwork with adhesive to ensure an air tight seal. Covers shall be capable of withstanding the respective system test pressures.

Any access openings cut in on site shall have the exposed cut edges covered with a protective band.

3056 HINGED ACCESS DOORS

Provide purpose made hinged access doors where indicated in accordance with DW 144. Fit access doors with latch style fastenings. All doors shall be supplied with approved retaining device fixed to door and frame. Access doors shall be capable of withstanding the respective system test. Provide full-face soft neoprene gasket secured to ductwork with adhesive to ensure airtight seal. Provide handles on all access doors.

3058 PRE-INSULATED DOORS AND COVERS:

On all insulated ductwork, provide standard access, inspection and cleaning covers and doors with (minimum) 25 mm thickness of insulation. Doors and covers shall be constructed and installed in such a manner that the internal face of the duct and cover/door is maintained when fixed. On insulated services all access covers/doors shall be fitted with raised stools, which shall be equal to the depth of the insulation.

3061 CONTROL/BALANCING DAMPERS - GENERAL

Dampers shall be provided where indicated on the drawings or called for elsewhere in the specification. Additionally the Contractor shall provide sufficient dampers to regulate and balance the system. Dampers on grilles or diffusers shall be used only for fine and secondary control. All dampers shall be sufficiently rigid to prevent fluttering.

Dampers constructed by the ductwork fabricator shall not be acceptable unless specifically agreed with the Designer in advance.

Dampers shall incorporate a locking device and blade position indication. A sample shall be submitted of the proposed dampers prior to the commencement of the installation.

After final balancing the quadrant shall have a small "V" shaped notch filed in the quadrant indicating the centre line of the lever when in the operating position.

On insulated ducts, the damper actuator quadrant and linkage shall be located proud of the external face of the duct insulation.

As a minimum control / balancing dampers shall be provided at the following locations:

At each fan
At each main branch
At each sub-branch
At any branch serving 3 or more terminals
At each terminal / grille

Where possible dampers on terminals / grilles shall be installed in duct connections rather than with the grille.

3062 CONTROL/BALANCING DAMPERS

Unless otherwise specified, provide extruded aerofoil section, plain opposed blade control and balancing dampers in accordance with DW/144 /or DW/154 Part 6 as appropriate. Manufacturers to confirm that dampers have been aerodynamically tested in accordance with BS EN 1751 and where required determination of sound power levels to be by measurement in a reverberation room in accordance with BS EN ISO 5135.

Provide locking device and position indicator on all dampers.

Dampers shall be single blade up to 200mm ducting height, elsewhere they shall be multi-blade, opposed blade type with each blade not exceeding 175mm in width and not longer than 1200mm.

Dampers shall be of the aerofoil blade (double skin) multi-leaf opposed blade type (unless otherwise specified) with the blades rigidly fixed to the horizontal spindles.

Each damper gear shall be suitable for operation over the pressure and temperature range of the medium being controlled.

Where dampers are required to operate to a fully closed position, dampers shall be of the low leakage type.

Remote blade operation

Where indicated, supply and install proprietary remote control unit (supplied by the damper manufacturer). Unit to be complete with all necessary brackets and linkage at the control unit. Control unit to provide indication of position of blades. Provide label at the control unit to indicate function.

3063 IRIS DAMPERS:

On final circular runs to and from terminals, provide iris pattern control dampers in accordance with DW/144 or DW/154 as appropriate. Provide each damper with locking device and position indicator.

3064 **MOTORISED CONTROL DAMPERS:**

Provide control dampers complete with motor, motor linkage and motor support. Motorised dampers shall generally be suitable for 24V on-off reversible motor and shall have a manual override facility.

The Contractor shall ensure they provide the controls specialist with full details of the damper selected and the total operating torque with damper in closed position, to enable the controls specialist to select a suitable actuator or actuators. The exact details of the actuator requirements shall be agreed with specialist controls supplier.

Damper motors, thrusters, positioners and remote operating gear (where required) shall be rigidly mounted on purpose-made brackets and carefully aligned.

Actuators shall have visual position indication and have the capability to provide positive feedback of position to the controls system.

3070A **FIRE DAMPER FUSIBLE LINKS:**

Supply spare fusible links for fire dampers and combination fire/smoke dampers. Supply ten in total or 1 for every 10 dampers installed (whichever is the greater). Supply links to fuse at temperature indicated

3071 **FIRE STOPS - PLASTICS DUCTWORK:**

N/A

3075 **FIRE DAMPERS GENERAL:** (NES 3070 & 3075 merged)

Provide fire dampers in accordance with DW/145, relevant parts of DW/144, DW/154 Part 6 paragraph 17 and clause Y30 4151.

Manufacturers to confirm that where required fire dampers have been aerodynamically tested in accordance with BS EN 1751 and where required determination of sound power levels to be by measurement in a reverberation room in accordance with BS EN ISO 5135.

Fire-resistance tests of thermal release mechanism in accordance with BS ISO 10294-4.

Types as scheduled: -

Multi-leaf fire dampers

or Intumescent fire dampers . Install in accordance with DW 144, size and location as shown on the drawings.
Fire resistance tests for intumescent dampers shall be in accordance with BS ISO 10294-5.

or Stainless steel shutter fire dampers with shutter blades out of the air stream.

or Multiple "Hit & Miss" steel plates fire damper

or Intumescent sleeves on plastic ductwork up to 350mm dia

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 a minimum integrity classification 'E' to meet that of the wall or floor.

When 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 otherwise 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 72^0C (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 CONTROL DAMPERS:
Smoke dampers shall comply with DW/145 and relevant parts of DW/144.

N/A

3089 COMBINATION FIRE/SMOKE CONTROL DAMPERS
N/A

3092 PRESSURE CONTROL FLAPS, STAINLESS STEEL FRAMES:
N/A

3093 WALL MOUNTED PRESSURE RELIEF DAMPERS:
N/A

3094 DOOR MOUNTED PRESSURE RELIEF DAMPERS:
N/A

3095 SHUT OFF DAMPERS:
Supply shut off dampers to give shut off of 100%.
Manufacture from sheet steel coated with polyurethane lacquer, suitable for either pneumatic, electro-pneumatic or electric/electronic control as required by the control system.

3096 NON RETURN DAMPER:
Supply non-return dampers where indicated/specified. Manufacture with galvanised sheet steel frame and aluminium blades.

3101 FLEXIBLE DUCTWORK: (NES 3100 & 4015 merged)
Supply flexible ductwork, insulated to same standard as used for the main distribution ductwork in accordance with DW/144. Installation to comply with BSRIA Guide BG43 - Flexible ductwork.
Material - Aluminium/Polyester laminate encapsulating high tensile steel wire helix.
Insulated ducts to have inner core of aluminium/Polyester laminate encapsulating high tensile steel wire helix, with mineral wool insulation and an outer core of aluminium and polyester laminate. Insulation
Building Control and Fire Officer Approvals shall be obtained for the use of the flexible ductwork to be installed.
Comply with BS EN 13180 and provide a test certificate proving compliance with the mechanical characteristics of this standard.

Flexible ductwork used to make final connection between distribution ductwork and terminal units and from terminal devices to supply grilles, it must be kept as short and straight as possible and shall not be used to take up gross misalignment. Maximum length of flex to be three diameters or 1m, whichever is the smaller.
Where the flexible ductwork is to be insulated, this shall be Class "O" fire rated.
The maximum frictional resistance to airflow per unit length of the flexible duct shall be agreed with the Designer. The radius ratio R/D for bends shall not be less than 2 where R is the centre line radius and D is the diameter of the flexible duct.
The flexible ductwork shall be to a standard of air tightness equal to that of the ductwork, and constructed to meet the fire precautions recommended in BS 9999 which comprise:-
Ductwork and insulation to have a test certificate proving reaction to fire performance requirements of BS 9999. Materials to conform to Euroclass A1 as specified in BS EN 13501 or when tested to BS 476-6 has a fire propagation index of not more than 12 and a sub-index of not more than 6.
Materials shall not produce smoke or toxic fume hazards if involved in a fire.
Support rings to be sized so as not to constrict the cross-sectional area of the ductwork. Duct support ring minimum width – 25mm.
Flexible ducts to overlap rigid duct or terminal device spigot by a minimum of 50mm
Make a seal between flexible duct and rigid connection using mastic sealant or duct tape.
Use a mechanical fixing for connection using a duct band.

3111 FLEXIBLE JOINT CONNECTIONS

Supply and install flexible joints as detailed in relevant parts of DW 144 or DW 154 as appropriate. Comply with relevant parts of BS 476.
All flexible joint connections shall comply with current Building Regulations regarding the spread of fire and smoke.
Position

Use flexible joints to make connections to:

Air diffusers, grilles and air registers,
On inlet and outlet connections to all fans or fan and attenuator assemblies,
At building movement joints, and
Elsewhere as indicated/specified.

On fans;

Flexible joints on fan connections shall be between flanged ends. The flexible material flange shall be backed by an angle or flat iron flange and the flexible joints shall be secured held between the metal flanges. Flat iron bands used with fan inlets shall be not less than 5 mm thick.
Flexible joints shall be equal in cross-section to the points of connection, not longer than 250 mm or less than 50 mm.

Properties

Flexible joints shall be "Neoprene" coated glass fibre or other materials excluding asbestos and have fire resistance properties of 30 minutes integrity. Class 1 surface spread of flame to BS 476: Part 7 and not produce smoke or toxic fume hazards if involved in a fire.

3120 BIRD WIRE GUARDS:

Fit bird screens of 12mm square mesh wire on all intake and extract louvres to atmosphere.
Wire gauge to be not less than 1mm.
Finish, plastic coated wire.

3130 INSECT GUARDS:

Provide insect guards where indicated scheduled.
Screens to be supplied in kit form for installation on site.
Material: Black PVC coated glass fibre mesh
Aperture size: 1.1x1.55mm
Weight: 155 g/m2
Free area: 62%

3132 SPREADER PLATE:

Provide duct mounted perforated inlet plate to humidifier sections to equalize air velocity over humidifier section.

3131 SEALANTS GASKETS AND TAPES:

For sealing materials and method of use comply with DW 144 Section 8 or DW 154 section 8 as appropriate. Gaskets or performed strips must be of an equivalent width to the faces of joint flanges. The use of self-adhesive tapes shall not be permitted. On circular ductwork chemical reaction sealing tapes may be used with the Designer's prior agreement. Sealants, gaskets and tapes shall be constructed using WRC approved sealants, gaskets, joints, adhesives etc, which will not support bacterial growth and which produce minimal fire or smoke hazards if involved in a fire, this to include attachments such as grilles etc.

3132 SPLITTERS:

Do not use splitters without obtaining written consent or unless the use of splitters is specifically specified. Construct splitters in same gauge and material as enclosing ductwork and attach to duct as described in DW 144 Part 3.

3133 TURNING VANES

Use square bends with turning vanes in all cases for flat, oval and rectangular ductwork unless otherwise agreed in writing.

3135A TURNING VANES-LOW AND MEDIUM PRESSURE

Provide double skin aerofoil pattern turning vanes in low and medium pressure ductwork. Construct vanes from material similar to enclosing ductwork. Fasten turning vanes as described in DW 144 Part 3.

3135B TURNING VANES-HIGH PRESSURE:

Provide turning vanes of double skin aerofoil pattern in high-pressure ductwork, constructed from material similar to enclosing ductwork. Fasten turning vanes as described in DW 144 Part 3.

3141 PRESSURE CONTROL FLAPS (Air pressure control valves)

N/A

3151 PRESSURE RELIEF DAMPERS:

N/A

3161 SHUT OFF DAMPER:

Supply shut off dampers to give shut off of 100%
Frame manufactured from galvanized sheet steel, blades to be double skin stainless steel with synthetic leading and trailing edge seals and double side seals suitable for electric/electronic control.

3171 NON RETURN DAMPER:

Supply non return dampers manufactured with galvanized sheet steel frame or aluminium alloy extrusions and aluminium blades supported on plastic moulded bearing surfaces

Ensure non return dampers in smoke handling systems have the required stability and integrity rating to match the system requirements.

4000 WORKMANSHIP

4011 GENERAL WORKMANSHIP:

Install ductwork in accordance with DW 144, DW 154 and DW 191 as appropriate. Ensure that there are no sharp edges or corners on cut edges on ductwork, flanges and supports.

Unless indicated otherwise, the outermost surface of exposed ductwork or insulation shall be not less than 100mm away from walls and ceilings to permit access for cleaning.

Ductwork shall be constructed such that all internal surfaces are generally smooth and will not normally retain moisture.

Ductwork shall be run generally parallel with walls and ceilings in order to circumvent building projections (or pass through structures where permitted) as shown on the drawings.

Internal roughness and obstruction to airflow (other than dampers, vanes etc) or sharp edges of corners on the outside of ductwork, flange supports etc shall not be accepted.

Weatherproof collars shall be provided where roofs or external walls are penetrated.

Attention shall be paid to the making and sealing of joints in ductwork, particularly where these occur on the blind side of a duct or are subsequently obscured by other parts of an installation or building fabric etc.

Install pre-insulated ductwork in accordance with manufacturer's instructions.

4015 PROTECTIVE FINISHES:

Comply with DW 144 for provision of protective finishes to ductwork. Make good welding damage..
Paint all bare edges and bare metal with two coats of zinc rich paint.
Provide any other special finishes as defined.

4021 HANGERS AND SUPPORTS WORKMANSHIP:

Support ductwork in accordance with DW 144, DW 154 Part 5; or DW 191 as appropriate.
Where insulation of ductwork is specified, install supports to ensure that the insulation can be easily applied and (where applicable) that integrity of vapour seal can be maintained. When installing vapour seal insulation blocks at supports, ensure there is complete vapour seal around the block prior to fixing the bracket. Blocks shall be the same thickness as the insulation and be of sufficient length either side of the support so as to enable vapour sealing on to the block. (Vapour sealing must not incorporate the bracket).

The Contractor shall purpose design supports for diagonally or vertically run ducting or shafts and other particular applications.

Where ducts or shafts are outside buildings or protective enclosures, and Local Authority regulations apply -
a) Submit detailed fabrication drawings to the Local Authority.
b) Obtain written evidence of Local Authority approval.
c) Submit drawings and evidence of approval to the Designer.

Where cantilever brackets or other special forms of support are required they shall be structurally strong enough to take the load and to transfer the imposed load to the building structure. Provide details of the loads imposed on the structure to the Structural Engineer.

The ductwork hangers shall be galvanised, adjustable and have, between the hanger and the ductwork, a gasket to prevent metal to metal contact.

Shot fired fixings shall not be permitted.

Bright zinc plated drop rods, nuts, bolts and washers shall be used on all supports.

All bearers shall be galvanised or zinc rich finish.

Two piece band clips, galvanised or zinc rich finish shall be used on circular ducts. Fig 65 (with drop rod) shall be used wherever applicable.

Flat oval ductwork – only Fig No 71 shall be permitted. Galvanised or zinc rich finish shall be used.

After all installation work is complete, cut back drop rods to ensure that projection through bottom bearer does not exceed twice the thickness of the securing nut.

On all cold services (i.e. below 15 degC), a vapour seal is required (including air inlets and downstream of heat reclaim coils). Ensure continuity of vapour barrier over ductwork support.

4022 APPEARANCE OF DUCTWORK SUPPORTS:
Cut off protruding ends of hanger rods and bolts close to nuts. Ensure that supports and drop rods are clear of ducts and not enclosed in thermal insulation, as DW 144 Section 19.6.

4023 PROPRIETARY SUPPORTS:
Use proprietary system of ductwork supports as appropriate. Obtain prior agreement from Designer of system to be used.

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.

4041 EXTERNAL DUCTWORK AND SUPPORTS:
N/A

4050 DUCTWORK FLOOR SUPPORT
Submit proposals to Designers for comment.

4054 AIRWAY OBSTRUCTIONS
Fit and secure rigid sheet metal fairings which are shaped to form rounded leading edges on the 'Upstream' ends, and tapered trailing edges on the 'Downstream' ends of obstruction.

4055 DUCTWORK VIBRATION ISOLATION
Ensure that ductwork does not come in direct contact with building fabric except in cases of fire dampers, silencers and builders frames. Isolate all supporting members/bearers from ductwork; secure lining of 6mm thick rubber, PVC or felt strip to support by means of adhesive.

4056 ACCESSORY SUPPORT:
In accordance with DW 144 Part 6 for supporting ductwork ancillaries. Submit details of supports to Designer for agreement.
Provide additional supports adjacent to dampers, diffusers and other items of equipment as necessary to prevent distortion.

4061 DRAINAGE OF DUCTWORK:
Arrange ductwork to drain any entrained moisture and ensure the lapping of joints prevents moisture leakage.

4071 CONNECTIONS:
Plant connections
Make connection between air handling assembly and ductwork system in accordance with DW 144 and manufacturers recommendations.
Connections to building openings
Comply with DW 144 Appendix K or DW 154 Part 6 as appropriate.

4080 EXPANSION JOINTS - PLASTIC DUCTS:
Provide expansion joints in accordance with DW 154

4091 INTERNAL CLEANLINESS:

Provide the level of care and protection as defined in BESA document TR/19, level as scheduled. Where level is not otherwise specified or scheduled, supply and recirculation systems are to be Advanced PDI level; extract systems are to be Intermediate PDI level.

Seal all open ends as installation proceeds by caps or blank flanges, to prevent ingress of foreign matter.
Cap material
Metal.
or Plastic.

Unless scheduled otherwise for installations to Advanced PDI level (and elsewhere as specified), all ductwork shall be thoroughly cleaned immediately prior to handover in accordance with TR/19 2013, using dry vacuum cleaners or a combination of the methods outlined in table 8 in TR/19 to ensure that no traces of dust, dirt or other foreign matter are present in the systems. To facilitate this requirement, provide cleaning access openings and covers in ductwork at intervals such that no point in the ductwork is more than 5 metres from an opening and elsewhere as required by TR/19. The location of the openings shall be selected by the contractor. Confirmation of the acceptability of the solution shall be obtained from a specialist cleaning contractor.

Comply with TR/19 section 7 and DW/172 in relation to kitchen extract systems.

4092 WET METHOD OF CLEANING:

Where specifically scheduled, the method of cleaning in accordance with the BESA Guide TR/19 - Wet cleaning, Table 8 shall be used.

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.

4101 WEATHERPROOFING

N/A

4111 DUCTWORK SLEEVES:

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 enclosing flanges on either side of wall where ductwork is exposed in rooms. Fix enclosing flanges back to wall to give a neat appearance.
Where finished insulation is carried through duct sleeves pack space between insulation finish and sleeve to form fire stop.

4121 FIRE RATED DUCTWORK SLEEVES:

Ensure fire rated ductwork sleeves, when required, are installed to the manufacturer's requirements.

4125 EXPANSION AND CONTRACTION

When installing long runs of air ducting, give attention to the direction of expansion or contraction movement due to thermal changes. Take up movement by flexible inserts.

4127 MOVEMENT AND NOISE

Prevent undue ducting movement, with consequent noise, by separating metallic contact surfaces with packing material, and interpose auxiliary flexible joints and anchoring supports along with ducting runs.

4131 INSTALLATION OF CONTROL EQUIPMENT

Fit sensors, damper motors and other control equipment as required. All control equipment 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

4141 INSTRUMENT CONNECTIONS:

Provide instrument connections as necessary.

4151 FIRE PRECAUTIONS:

Install fire dampers, smoke dampers and fire/smoke dampers as necessary to meet the fire compartmentation of the project. Refer to architects drawings for fire compartmentation.

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.

4171 POSITIONING:

Position components in accordance with manufacturer's instructions as shown on the manufacturer's drawings or specialist supplier's drawings or specialist contractor's drawings as appropriate.

4181 FLEXIBLE DUCTWORK, WIRE LOOP TIES:

Ensure that flexible ductwork does not become kinked or flattened. Support flexible ductwork using wire loop tie supports to prevent sagging.

10000 Based on NES Y30 TEXT Dec 19

1000 GENERAL MECHANICAL PERFORMANCE, COMPONENT RATINGS / SELECTION

Mechanical performance - BS EN 1886 (refer to schedule for casing strength, air leakage thermal transmittance and thermal bridging classifications and general acoustic performance)

General requirements, ratings and performance for units as a whole, components and sections in accordance with BS EN 13053.

Fit clean filters in all air handling systems (AHU's and any duct mounted units) before the fans SFP values are checked at commissioning. When clean filters are fitted check the specific fan power SFPv for calculation of the building as constructed CO_2 emission rate.

Heat exchangers and recovery equipment to comply with BS EN 305, BS EN 306, BS EN 307, and BS EN 308 as appropriate to the application.

For Healthcare applications comply with HTM 03-01. Should there be a conflict between this design guide and clauses in this specification HTM 03-01 shall take precedence.

Fans driven by electric motors with electric input between 125W and 500kW to comply with EC Regulation 327/2011 with regard to ecodesign requirements.

Comply with EU regulation 1253/2014 for small packaged ventilation units comprising fan(s), heat recovery system, filters and controls (or a combination of these components) up to 1000m^3/hr with regard to eco-design requirements.

1005 LOCATION:

Supply air handling units suitable for positioning as indicated.

1007 DESIGN DUTIES FOR FANS IN AHU'S: (NES 1020)

Supply air handling units to meet air volumes and external resistances, as indicated.

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 and any changes made by the contractor to the ductwork layout, quantities and types of bends etc from that indicated on the tender drawings

Operating Point

Select operating point on pressure/volume curve to provide stable and efficient operation. Fans shall be selected to give the lowest possible noise rating having regard to their duty and type.

Whenever possible the fan supplier shall select fans over the range of air flows where the efficiency is not less than 85 % of the optimum efficiency in accordance with Annex E in BS EN ISO 12759.

Guaranteed Performance

Provide fan performance figures in accordance with BS EN ISO 5801, BS 848-1 and BS 848-9, ISO 13348.

Quoted fan duties are based on pressure losses external to the AHU and on the equipment air side pressure losses as scheduled in Y40sch.

1010 AIR LEAKAGE (CASING AND FILTER BY-PASS):

Ensure air handling unit is sealed.

Unless scheduled otherwise the maximum AHU casing leakage rate shall be a function of the air filters within the air handling unit. Leakage rates at the test pressures defined in BS 1886 shall not exceed rates defined in the relevant tables within BS EN 1886. (Table 4 for 400 Pa negative test pressure and Table 5 for 700 Pa positive test pressure)

Filter bypass leakage, at 400Pa test pressure, shall not exceed the acceptable maximum % of volume flow rate defined in BS EN 1886 for the class of filter scheduled or detailed in the particular specification.

Provide special requirements as indicated or scheduled.

2000 PRODUCTS/MATERIALS

2021 DOUBLE SKIN CASING AIR HANDLING UNITS:

Outer skin material

Zinc coated steel hot dip galvanized to BS EN 10346 or BS EN 10143, or Plastic coated galvanized sheet steel unless otherwise indicated.

Inner skin material

As outer skin

Outer and inner skin material

Construct double skin panels from proprietary building panels.

External casing / frame finish

Painted, three coats, with high quality gloss top coat colour to BS 4800 as indicated, or stove enamelled, unless otherwise indicated. If the manufacturer's proposals differ from this standard then details shall be submitted to the CA for comment prior to manufacture.

Internal casing / frame finish

Painted, three coats, with high quality gloss top coat colour to BS 4800 as indicated, or stove enamelled, unless otherwise indicated. If the manufacturer's proposals differ from this standard then details shall be submitted to the CA for comment prior to manufacture.

2030 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 the values given in table 2 of BS EN 1886 when in operation at the maximum fan pressure at selected design fan speed. Refer to schedule Y40 for class.

Casing Class D1 - 4mm/m maximum relative deflection.

Casing Class D2 - 10mm/m maximum relative deflection

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 frame to prevent cold bridging and the risk of surface condensation when there are large temperature differences between inside and outside or when the air handling unit is located externally.

Stacking or vertical units

Configuration to be as scheduled. Strengthen framework to support additional weight.

Casing thermal performance

Ensure the casing thermal performance is tested in accordance with the requirements of BS EN 1886.

Thermal transmittance U of the casing shall be classified in accordance with Table 8 of BS EN 1886. - Refer to schedule Y40 for class required.

Thermal bridging factors Kb shall be classified in accordance with Table 9 of BS EN 1886. Refer to schedule Y40 for class required.

Casing acoustic performance

Ensure that the sound insertion loss of the unit is determined in accordance with BS EN 1886

Casing Insulation

Ensure insulation complies with BS 476 parts 6 & 7. Where extract sections are used for high temperature smoke extract mineral wool shall be used. Ensure insulation is fixed securely to panel and protected to prevent migration of fibre into air flow. Insulation shall provide thermal and acoustic treatment. Insulation to be inorganic, vermin proof and non-hygroscopic. Provide insulation to achieve acoustic performance as indicated and meet the requirements of Y50 (ductwork)

Ensure insulation is vapour sealed throughout and incorporate thermal breaks

Framework

Ensure framework is self-supporting and rigid enough to prevent distortion during transportation and final assembly on site.

For vertical units strengthen framework to support additional weight

Frame construction shall be welded, rolled or extruded with purpose made corner joints or pentapost type frame with purpose made corner joints.

If frame is welded ensure welds are ground flush and painted with an appropriate protective paint.
Insulate framework if it is considered that there is a risk of surface condensation.
Provide formed or RSC base with unit.

Ensure unit satisfies the fire protection criteria given in BS EN 1886.
Ensure unit satisfies the mechanical safety criteria given in BS EN 1886.
Casing finish to be as clause 2021

2041 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
Lockable tee bar handles, or levers.
Provide access openings to fans, damper sections, filters, coils, inspection chambers, humidifiers, and additionally as indicated (access openings to humidifiers to have vision panel).

Permanent Access Platforms for double deck AHU's
Where top of upper deck is 3m above FFL of general access area, design, supply and install permanent maintenance access platforms for double deck AHU's complete with handrails and toeboard / kick plate on all open sides of the platform, details as scheduled. Where access ladders are incorporated , they shall comply with BS 4211.
Platform and means of access to comply with Work at Height Regulations 2005 and relevant parts of BS EN ISO 14122
Materials – galvanised steel, with open mesh flooring.

2042 LIGHTING

Provide a suitably IP rated bulkhead light (compact fluorescent type) in each of the access and fan sections. Lights to be switched by a switch mounted on the side of the unit.
Provide all wiring as part of AHU package. Wire separately to Fan Motor. Terminate in a terminal box mounted on the unit. Power supply to the lighting shall be provided by the Controls Specialist from separately fused ways in the nearest MCC or distribution board within the plant room.

2050 WALK – IN AIR HANDLING UNITS:

N/A

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2061 EXTERNAL AIR HANDLING UNITS:

N/A

3000 ACCESSORIES/COMPONENTS

3011 FAN SECTION:

Generally
Comply with the requirements of Y41 and Y92. Provide fan aerodynamic performance tests in accordance with BS EN ISO 5801, BS 848-1; noise tests in accordance with BS EN ISO 5136 and Parts 1-4 of BS ISO 13347; fan vibration measurements in accordance with BS ISO 14695 and balancing and vibration measurements in accordance with BS ISO 14695.
Fans for use in potentially explosive atmospheres / flameproof zones to be in accordance with BS EN 14986 and relevant parts of BS EN 13463 or BS EN ISO 80079 and relevant parts of BS EN IEC 60079 / BS EN 60079 series and be compliant with the ATEX directive.

Provide frame for motor and fan and comply with fire regulations. Ensure frame is isolated from casing.

Mount motor internally (or externally if so indicated).
For blow through units, ensure air flow in downstream sections of unit have relatively uniform velocity profile.

Supply fan guards to BS EN ISO 12100 and BS EN 12499

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, and additionally as indicated.

Anti-Vibration mounts

Provide anti-vibration mounts with a minimum of 25mm static deflection to isolate fan & motor from the casing

Drive

Direct, or belt driven as scheduled.

Provide belt driven fans with two or more belts. For each belt driven fan provide a change of belts and drives (to be sized after balancing the system). Allow for changing belts and drives and recommissioning fan and rechecking system as necessary.

Fit variable speed drives to all fans rated at more than 1.1kW and as scheduled.

Provide fan guards to fan motors

3020 FILTER SECTION:

Provide frames to allow withdrawal of filters.

Panel and bag filters shall be replaced with new, after commissioning and before the AHU SFP_v (Specific fan power) is checked for Building Regulations Part L compliance. Filters shall be constructed such that no harmful fibres are carried out into the airstream.

Panel filters shall be constructed from water resistant materials.

Filters and frames in gas fired units shall be capable of withstanding temperatures that could result following a power failure or air flow failure (ie no run of fan).

Surfaces of air filters should be inherently non-flammable or so treated as to make them non-flammable for the duration of their recommended working life.

Test filters for general ventilation to relevant parts of BS EN 16890 as classified to BS EN ISO 16890-1 as scheduled.

Test high efficiency air filters (EPA, HEPA and ULPA) as classified BS EN 1822-1 to relevant parts BS EN ISO 29463 as scheduled.

Test gas-phase, (known as molecular or activated carbon filters) air cleaning media to BS EN ISO 10121-1 and devices to BS EN ISO 10121-2 as scheduled.

3031 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.

The maximum air velocity through coils shall not exceed 4m/s

Rated performance shall be rated in accordance with BS EN 1216

3032 GAS FIRED HEATING SECTION (NES base clauses 243.054 / 243.056)

N/A

3041 COOLING COIL SECTION:

N/A

3042 PLATE HEAT EXCHANGER (RECOUPERATOR):

Refer to clause Y43 2072 for materials and workmanship requirements
Minimum dry heat recovery efficiency - 50% (actual energy transferred / maximum possible energy transfer) unless scheduled otherwise.
Internal leakage < 1%
Limiting pressure drop < 250Pa

3043 THERMAL WHEEL:

Refer to clause Y43 2073 for materials and workmanship requirements
Minimum dry heat recovery efficiency - 65% (actual energy transferred / maximum possible energy transfer) unless scheduled otherwise.
Internal leakage < 5%
Limiting pressure drop < 200Pa

3044 RUN AROUND COILS:

N/A

3045 DETAIL SPECIFICATION OF COMPONENTS:

For further details of:

Filters seeY42 clauses and Y40 schedule of air handling units
Coils and heat recovery equipment see Y43
Humidifiers see Y44
Attenuators see Y45
Louvres Y45 (acoustic) and Y46
Vibration isolation Y52.

3051 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. As a minimum
Provide the following;

Drain pans shall be fitted under cooling coils and Humidifier, laid with a minimum fall of 1 in 20 in all directions towards a bottom drain connection. Side drain connections shall not be acceptable. Drain pans shall be removable for cleaning.
Traps shall be in glass unless otherwise indicated.

A space of not less than 600mm shall be provided on either side of cooling coils and humidifiers to facilitate inspection, cleaning and maintenance.

Removable walkways shall be provided over flooded chambers.
All ferrous metal surfaces shall be treated to prevent corrosion.
Eliminator plates, where provided, shall be withdrawable for cleaning.
No materials which support bacterial growth shall be used in any of these assemblies. Such materials include some jointing compounds, rubber, mastic, wood and some plastics.

On all cooling coils provide drain trap of at least twice working air pressure in depth.

Provide an air break between trap outlet and drainage system. Pipe each trap to drain via a tundish or pipe each trap separately to discharge over a gully to prevent the potential of cross contamination between AHU's.

3055 HUMIDIFIER SECTION:

N/A

3061 CONTROL DAMPERS:

Provide control dampers in accordance with DW 144.

Control damper type

Iris dampers, Multi-leaf dampers, or as otherwise indicated.

Section

Double skin section, unless otherwise indicated.

On large dampers arrange as multiple sections with individual actuators, to ensure correct operation.

Blades

Double sealed opposed blade, unless otherwise indicated.

Ancillaries

Position indicator, Locking device, and as indicated.

Motorized control dampers

Provide control dampers complete with extended spindle, and motor, motor linkage and motor support (details to be agreed with the specialist Controls supplier), unless otherwise indicated.

Ensure damper motors are selected to match torque rating of dampers.

3071 CONTROLS:

Provide control panels where required and detailed in the schedules or scope of works.

3081 FACTORY INSTALLED ACCESSORIES:

Provide the following in addition to scheduled items

protected wireways for power, lighting and control wiring.

external terminal boxes for all electrical components.
mounting plates for control and sensing devices.
internal access platforms to components above 1.8 metres.
vision panels to humidifier sections and as indicated.

4000 WORKMANSHIP

4011 COMPONENT ASSEMBLY:

Make up air handling units from standard modular components assembled such that air cannot by-pass active components and airflow is even throughout unit.

Assemble air handling units using gasket to prevent air leakage from casing.

Site drilling

Do not carry out any site drilling without prior agreement.

4020 ACCESS:

Ensure air handling units are positioned to allow adequate space for maintenance and access.

4030 HUMIDIFIER INSTALLATION:

Comply with manufacturer's installation instructions for steam electrode type of humidifier.

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. 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.

means of isolating pipework to air handling units to allow maintenance and repairs to be carried out.

means of isolating steam to humidifier when access door is opened.

4071 DRAINAGE OF FREE WATER:

Make provision for free water to be caught, collected and drained away.

Provide U-traps on all drains having a minimum depth of twice the maximum negative/positive pressure created by the fan. Allow for turbulence in the trap when selecting it.

Provide traps with a facility to allow the “topping up” of dry traps.

4081 **SUPPORT AIR HANDLING UNIT**

On builders work base, unless otherwise indicated.

4091 **FACTORY TESTS:**

Carry out tests at the factory as scheduled.

Factory tests can be tests undertaken by the manufacturer on a type basis.

Tests shall be in accordance with BS EN 1886 and BS EN 13053

Air flow performance test in accordance with BS 6583.

4101 **TESTING PRIOR TO INCORPORATION IN WORKS:**

Carry out testing to measure the parameters as scheduled

Tests shall be in accordance with BS EN 1886 and BS EN 13053.

Air flow performance test in accordance with BS 6583.

10000 Based on NES version Y40TEXT Dec 19

1000 GENERAL

Standards

Provide fans manufactured and tested in accordance with appropriate British Standards.

With regard to safety requirements, comply with BS EN 60335-2-80 where applicable.

Fans for smoke and heat control to be in accordance with BS EN 12101-3

Fans for use in potentially explosive atmospheres / flameproof zones to be in accordance with BS EN 14986 and relevant parts of BS EN 13463 or BS EN ISO 80079 and relevant parts of BS EN IEC 60079 / BS EN 60079 series and be compliant with the ATEX directive.

Inline and chimney outlet exhaust fans to comply with BS EN 16475-2

Kitchen extract fans to comply with BESA DW / 172.

Fans driven by electric motors with electric input between 125W and 500kW should comply with EC Regulation 327/2011 with regard to ecodesign requirements.

Comply with EU regulation 1253/2014 for small packaged ventilation units comprising fan(s), heat recovery system, filters and controls (or a combination of these components) up to 1000m^3/hr with regard to ecodesign requirements.

1005 APPROVED FIRMS:

Select fans from Quality Assured firms registered under CAME scheme, unless otherwise indicated.

1011 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 and any changes made by the contractor to the ductwork layout, quantities and types of bends etc from that indicated on the tender drawings

Operating Point

Select operating point on pressure/volume curve to provide stable and efficient operation. Fans shall be selected to give the lowest possible noise rating having regard to their duty and type.

Whenever possible the fan supplier shall select fans over the range of air flows where the efficiency is not less than 85 % of the optimum efficiency in accordance with Annex E in BS EN ISO 12759.

Guaranteed Performance

Provide fan performance figures in accordance with:

BS EN ISO 5801 for all types except those designed solely for air circulation.

BS 848-9, ISO 13348 for tolerances, methods of conversion and technical data presentation.

BS EN ISO 13350 for testing of jet fans.

Quoted fan duties are based on pressure losses external to the fan unit and on the equipment air side pressure losses as scheduled in Y41sch.

Before ordering the fans, the contractor shall adjust the fan static pressures to suit pressure drops of actual components used in the systems

Adjust fan heads if changes are made to ductwork routing or arrangement in preparation of installation drawings or details.

Quoted fan duties include the following commissioning allowances:-

	Low Pressure Systems	Medium & High Pressure Systems
On Flow Rates	10 %	5%
On Head	20%	15%

Allow for a pulley and belt change on belt driven fans and impeller change or angle adjustment on direct drive fans.

1020 PROTECTION:

Protect casings, impellers and shafts against corrosion. Protect bearings against dirt and moisture.

1061 FAN MOTORS

Comply with reference section Y92 clauses.

1065 FAN MOTOR STARTERS

Incorporated in Controls - reference W60.
Comply with reference section Y72 clauses.
Fit variable speed drives to all fans rated at more than 1.1kW and as scheduled.

2000 PRODUCTS/MATERIALS

2010A OPERATING CONDITIONS:

Installation arrangement as shown on drawings.
Configuration

Parallel or series operation as shown on drawings.

Sound Power Level

Select fan, motor, drive and speed control system not to exceed sound power levels or sound pressure levels scheduled or specified elsewhere. Provide sound power data in accordance with BS EN ISO 5136 and parts 1-4 of BS ISO 13347

Select plant that does not have a distinguishable, discrete, continuous noise or give rise to distinct impulses.

Air Density

Relate fan performance to air density 1.20kg/m3.

Temperature Range

Minimum to maximum operating temperatures –10°C to 40°C or as scheduled / indicated.

2010B POTENTIALLY EXPLOSIVE ATMOSPHERES

Constructional requirements:

N/A

2020A CONSTRUCTION AND HANDLING:

Casings

Construct rigid casing free from drumming under operating conditions.
Flange dimensions to BS EN ISO 13351
Supply in sections as required for access or handling.

Safety Standards

BS EN 60335 – 2 – 80 for the safety of electric fans for household and similar Purposes.
BS EN ISO 12499 – for guarding

Rotating assemblies

Balance in accordance with relevant parts of BS ISO 21940.

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 for general principles of design and HSE requirements.
Material - galvanized or sheet steel.

Lifting

Provide lifting eyebolts or similar facilities on fans or sections heavier than 20kg.

2031 TESTING:

Provide results of aerodynamic performance tests in accordance with BS EN ISO 5801, BS 848-1; noise tests in accordance with parts 1-4 of BS ISO 13347 and /or BS EN ISO 5136 as appropriate and fan balancing and vibration measurements in accordance with BS ISO 14695, BS 848-6.

The minimum energy efficiency requirements for fans driven by electric motors with electric input between 125W and 500kW should comply with EC Regulation 327/2011.

2050A MATERIALS - GALVANISED SHEET STEEL:

Construct casing from galvanised sheet steel in accordance with BS EN 1S0 1461, BS EN 10326, BS EN 10327.or BS EN 10143 unless scheduled otherwise.

2060z MOTOR:

Speed

Single, two or variable speed, as indicated.

Standards

Where variable speed drives are fitted to direct drive fans, ensure the drive meets the safety requirements of BS EN 61800-5-1. Comply with Y72 and Y92 clauses

Options:

When fan is handling saturated or corrosive air, provide motor ventilation to clean air,

2065 DRIVE / COMMISSIONING ALLOWANCES:

Direct, or belt driven as scheduled.

Provide belt driven fans with two or more belts. Belt drives shall comply with BS 3790.

For each belt driven fan provide a change of belts and drives (to be sized after balancing the system). Allow for changing belts and drives and recommissioning fan and rechecking system as necessary.

For each direct drive, adjustable pitch, axial fan, allow for a change of pitch angle (to be determined after balancing the system). Allow for recommissioning each system after the fan blade pitch change.

Refer to schedules for commissioning allowances included in duties.

2070A AXIAL FLOW FANS:

Fan impeller and casing aerodynamic efficiency

Manufacturer's standard to achieve overall efficiency of the fan, motor and drive combination scheduled or detailed elsewhere in the project particular specification.

Operation

Single; two in series; or multi-stage contra- rotating as indicated.

Bearings

Provide bearings suitable for mounting and direction of flow as shown on drawings.

Impellers

Fixed pitch; or adjustable pitch as indicated.

Casing - enclosing impeller and motor.

2080A SINGLE INLET SINGLE WIDTH CENTRIFUGAL FANS:

Fan impeller and casing aerodynamic efficiency

Manufacturer's standard to achieve overall efficiency of the fan, motor and drive combination scheduled or detailed elsewhere in the project particular specification.

Operation - single.

Impeller Design

Supply fan with impeller to suit operating conditions indicated.

Casing - single inlet single width.

Mounting - channel frame.

Drain

Fit drain connection at lowest point of scroll as indicated.

2080C DOUBLE INLET DOUBLE WIDTH CENTRIFUGAL FANS:

N/A

2090A PROPELLER FANS:
N/A

2100A MIXED FLOW FANS:
N/A

2200z CONSTRUCTION OF SMOKE EXTRACT FANS AND NATURAL VENTILATORS (U14 300.021):
N/A

3000 ACCESSORIES

3010 INSPECTION DOORS - AXIAL FANS:
Fit air-tight inspection doors giving access to drive motors and other components requiring regular servicing or maintenance.

3020 INSPECTION DOORS - CENTRIFUGAL FANS:
Fit air-tight doors in scroll and cover.

3030 INSPECTION DOORS - PROPELLER FANS:
For diaphragm mounted fans fit an air-tight inspection door positioned to give access to drive, or other sub-components requiring regular servicing or maintenance.

3040 INSPECTION DOORS - MIXED FLOW FANS:
Fit air-tight doors giving access to drive motors and other components requiring regular servicing or maintenance.

3041 ACCESS PANELS – KITCHEN EXTRACT FANS
Access panels fitted to the casing shall be the full width of the impeller and located to facilitate cleaning and maintenance.

3050A GUARDS:
Provide guards in accordance with BS EN ISO 121000.
Fit safety guards on air inlet and air outlet connections where these are freely accessible to personnel in accordance with BS EN ISO 12449, BS 848-5.
Provide bird guards unless fans are protected elsewhere (eg by birdguards at louvres).

3060z CONNECTIONS TO DUCT:
Provide flexible connections unless otherwise indicated.

3070A GUIDE VANES - AXIAL FANS:
Supply fan with integral downstream guide vanes. Or guide vane unit fitted upstream, or as otherwise indicated.

3080 GUIDE VANES - CENTRIFUGAL FANS:
Fit automatically controlled inlet guide vanes to inlet of fan.
Provide an actuating device for each set of inlet guide vanes.

3090 GUIDE VANES - MIXED FLOW FANS:
Fit automatically controlled guide vanes.

3100z SHUTTERS:
Fit shutters to prevent reverse flow through fan.
Back draft shutters or motorized shutters as indicated.

3110 AIR FLOW SENSORS:
Fit air flow sensors on twin fan units to sense fan failure and provide automatic changeover to standby fan.

3120 ACCESS:
Provide access via hinged casing or as otherwise indicated.

3141 SPEED CONTROLLER:
Where provided, ensure speed controllers are matched to fans.

3150 STANDBY MOTOR:
Provide standby motor as indicated.

4000 WORKMANSHIP

4010 LOCATION:
Install fans in positions indicated, in accordance with manufacturer's instructions and recommendations in CIBSE TM 42 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.

4051 DRAIN CONNECTION:
Fit trap to drain connection at lowest point of scroll on centrifugal fans unless otherwise indicated.

10000 Based on NES Y41text Dec 19

1005 DUTY AND PERFORMANCE:

Supply filters to meet duty and performance / classification scheduled.

Provide pressure data as initial pressure loss at rated airflow and recommended final pressure loss.

Filters and frames in gas fired air handling units shall be capable of withstanding temperatures that could result following a power failure or air flow failure (ie no run of fan).

Fit clean filters in all air handling systems (AHU's and any duct mounted units) before the SFPv value is checked.

Surfaces of air filters should be inherently non-flammable or so treated as to make them non-flammable for the duration of their recommended working life.

Classification of filters for general ventilation in accordance with BS EN ISO 16890-1 as scheduled.

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.

2000 PRODUCTS/MATERIALS

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.

2018 ACCESS:

To be front, side, bottom or top withdrawal, to suit installed position.

2020B FILTER TESTING: (NES 242.020)

Test filters classified to BS EN 16890-1for general ventilation in accordance with BS EN ISO 16890 Part 2, 3 and 4

BS EN ISO 16890-2. Measurement of fractional efficiency and air flow resistance.

BS EN ISO 16890-3. Determination of gravimetric efficiency and air flow resistance versus mass of test dust captured.

BS EN ISO 16890-4. Conditioning method to determine the minimum fractional test efficiency.

Test high efficiency filters classified to BS EN 1822-1 in accordance with relevant parts of BS EN ISO 29463.

Test gas-phase, (known as molecular or activated carbon filters) air cleaning media to BS EN ISO 10121-1 and devices to BS EN ISO 10121-2.

2040z PANEL FILTERS:

Ensure filter media is retained in frame.

Filter Media

Disposable

Down to 2 microns - glass fibre with scrim.

Down to 5 microns - composite fibre materials.

Filter frames

Water resistant cardboard or aluminium.

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.

2070 HIGH EFFICIENCY AIR FILTERS:

Standards

BS EN 1822-1 (for classification, performance testing, marking). Refer to equipment schedules for required classification).

BS EN ISO 29463-2 (for measuring equipment and particle counting statistics).

BS EN ISO 29463-3 (for testing flat sheet media).

BS EN ISO 29463-4 (for test method for determining leakage of filter elements).

BS EN ISO 29463-5 (for test method for filter elements).

Filter media

EPA (Efficient Particulate Air) filter media - Group E

HEPA (High Efficiency Particulate Air) filter media - Group H.

ULPA (Ultra Low Penetration) filter media - Group U.

Filter casing with fitted gasket

Mild steel with corrosion resistant coating or stainless steel or anodised aluminium.

Filter testing / marking

Test each HEPA cell to relevant parts BS EN ISO 29463 and mark on a plate/label fixed to filter casing.

2080A ACTIVATED CARBON FILTERS:

Provide absorbent bed filled with uniform thickness of activated carbon granules constructed to N/A

2081 FLAMEPROOF FILTERS

N/A

3010z PRESSURE GAUGE:

Install dial-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. Where remote monitoring of filter condition is to be provided, install pressure differential switch or sensor for warning of "Filter Blocked Condition".

3020 FILTER HOUSING:

Provide filter housing to hold banks of filters rigidly in place.

3030A TERMINAL FILTER HOUSING, GASKET SEALS:

Supply terminal filter housing for EPA, HEPA and ULPA filters.

Housing seals

Provide gaskets to seal between holding frames on banks of filters.

3030B TERMINAL FILTER HOUSING, STEEL FRAME WITH EPOXY RESIN SEAL:

Supply terminal filter housing for EPA, HEPA and ULPA filters.

Housing seals

Seal filter into rigid epoxy resin finished steel casing with hard setting synthetic resin cement.

3040z SAFE CHANGE FILTER CHANGING UNIT:

N/A

3051 SPARES:

Supply spare panel and bag filters for each AHU and duct mounted filter.

3060 CLEANING:
Supply cleaning materials for metal plate filters, supply sufficient coating solution for one complete cleansing operation.

3071 MOUNTING FRAMES:
Where filter is mounted in walls or partitions, provide, complete with building-in ties and epoxy resin coated mild steel matching frames.

4000 WORKMANSHIP

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.

10000 Based on NES version Y42 TEXT- Dec 19

1012 DESIGN DUTIES:

Supply equipment to meet dynamic insertion losses or acoustic performance indicated with resistance to air flow as indicated with any specific requirements or limitations as indicated.

Note: Plastic films used to protect infill from moisture or grease ingress may reduce the acoustic performance. Where this method of protection is employed, due allowance shall be made for any loss of performance when selecting equipment to meet the specific insertion loss or acoustic performance.

1020z TESTING:

Manufacturers shall provide certified insertion loss data as defined and derived in tests to BS EN ISO 7235, for each of the eight octave bands.

Generated sound power levels in dB (re 10^{-12}Watts) shall also be provided along with certified insertion loss data for each silencer duty.

Where equipment is manufactured in modules, the performance ratings shall apply to the unit as a whole.

1030z PROTECTION:

Where silencers are to be exposed to external weather conditions, their inner and outer surfaces shall be protected in accordance with the relevant ductwork specification.

Silencers are to be delivered to site with blocked ends to prevent damage.

Provide suitable bracing and restraint, for both transportation and storage, to maintain acoustic and physical integrity.

1040 DIRECTION OF FLOW:

Clearly mark direction of air-flow on silencers.

2000 PRODUCT/MATERIALS:

2010z FIRE PROPERTIES:

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 or Class 0 as required by Building Control/Fire Officer.

2020z CIRCULAR SILENCERS - CASING TO DW/144:

Provide circular silencers compatible with ductwork installation.

Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic, and non-combustible.

Construct casing to DW/144 with external flanges drilled for bolting to counterflanges on adjacent plant or ductwork, or with spigot ends where not connected to ductwork.

Retain infill by perforated galvanized mild steel sheet

Comply with IGE/UP/10 and BS 6644 for attenuators in flue dilution systems. Material of construction to be 304 stainless steel.

2030z CIRCULAR SILENCERS - NON-METAL:

Provide circular silencers compatible with ductwork installation.

Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic, and non-combustible.

Provide with external flanges drilled for bolting to counterflanges on adjacent plant or ductwork, or with spigot ends where not connected to ductwork.

2032z 'MELINEX' LININGS TO SPLITTERS AND SILENCERS:

Unless scheduled otherwise provide a “Melinex” lining in front of the infill in the following systems:

- Systems serving clinical areas in healthcare applications
- Systems serving clean rooms
- Systems where cleaning is required including kitchen extract
- Systems where the acoustic louvre will be handing moisture or chemically laden air

Where a 'Melinex' lining is to be included in front of the infill to prevent product migration or contamination of the infill it shall be greater than 23µm thick.

Full account of the reduction in performance of the silencer brought about by the addition of the lining shall be made when selecting silencers to meet the required performances.

2040z RECTANGULAR SILENCERS - CASING TO DW/144:

Provide rectangular silencers compatible with ductwork installation.

Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic, and non-combustible.

Construct splitters with low loss fairings where required to achieve pressure drop performance.

Construct casing to DW144 with external flanges drilled for bolting to counterflanges on adjacent plant or ductwork, or with spigot ends where not connected to ductwork.

Retain infill by perforated galvanized mild steel sheet

Comply with IGE/UP/10 and BS 6644 for attenuators in flue dilution systems. Material of construction to be 304 stainless steel.

2041z ACOUSTIC SPLITTERS:

Fix half width splitter to each side wall or as indicated.

Construct splitters to ensure that infill is retained and individual acoustic integrity is maintained.

Construct splitters with low loss fairings on entry and exit where necessary to meet pressure loss requirements.

Provide additional stiffening on horizontally mounted splitters.

Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic, and non-combustible.

Retain infill by perforated galvanized mild steel sheet unless otherwise indicated.

2050z RECTANGULAR SILENCERS - NON-METAL:

N/A

2051z AIR TRANSFER/CROSS TALK ATTENUATORS:

Provide attenuators for air transfer and cross talk applications where indicated.

Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic, and non-combustible.

Construct splitters with low loss fairings where required to achieve pressure drop performance.

Construct casing to DW/144 or compatible with ductwork installation.

Provide external flanges drilled for bolting to counterflanges on adjacent plant or ductwork, or with spigot ends where not connected to ductwork.

2080z ACOUSTIC LININGS, PERFORMANCE TO BS EN ISO 354:

Line internal surfaces of ducts as described in DW/144.

Provide lining that is inert, fire proof, inorganic, vermin proof, non-hygroscopic and non-combustible.

Material - polyurethane foam, melinex lined.

Lining to achieve the following minimum random incidence absorption coefficients in accordance with BS EN ISO 354, or as indicated.

Frequency Hz	125	250	500	1k	2k	4k
	0.15	0.25	0.5	0.7	0.8	0.9

Protect lining against product migration and erosion.

2090z ACOUSTIC INSULATION:

Where indicated provide acoustic insulation.

Provide flexible system unless indicated otherwise. Supply with associated acoustic insulation as a factory made composite whenever possible.
Standard: Tested and rated in accordance with relevant parts of BS EN ISO 10140
Fire resistance: Class O Building Regulations when tested to BS476 -6 and BS 476-7.
Flexible system

Continuous quilted mineral (rock) fibre mat of density not less than 45kg/m^3 or foam at least 50mm thick with sandwich layer of polymeric material, minimum 1mm thick, with minimum mass of 10 kg/m^2 (unless scheduled otherwise elsewhere in the particular specification). Ensure surface finish complies with BS 476 - 7, Class 1 as a minimum. The polymeric mass layer should be positioned outermost from the sound source and overlapped at all joints. The product must be designed to maintain its original thickness subsequent to installation. The lagging should be cut 25mm oversize and a 25mm strip of the inner resilient element removed to create an overlap. The mass layer must not come in contact with the duct of pipe
Overlap and seal all joints with adhesive and external reinforcing tape.
Overlap and seal all joints with adhesive and suitable external reinforcing tape.

Particular attention should be paid to support the acoustic lagging at joint locations and where sagging may occur, eg in “soffit” areas.

For circular applications including soil-vent and rainwater pipes, ductwork etc, the lagging should be secured in place, either by using integral self-adhesive overlap or an alternative method approved by the SO. For vertical installations above 3m additional support should be provided in the form of aluminium bands at 200mm.

2120 ACOUSTIC LOUVRES: (Refer to Y46. 2252)

2140z ACOUSTIC ENCLOSURES:
Construct wall panels, frames and floor panels to meet the performance indicated, from materials suitable for location.
Ensure joints provide adequate seal to meet requirements.

Achieve minimum random incidence absorption coefficients in clause 2080z in accordance with BS EN ISO 354, unless otherwise indicated.
Provide inspection windows where indicated.
Supply cable access floor panels where indicated.

3000 WORKMANSHIP

3010 GENERAL:
Install acoustic treatment equipment in positions indicated, in accordance with manufacturer’s instructions.

3020 ACOUSTIC ENCLOSURES:
Ensure that erection is carried out by enclosure manufacturer.

3030 ACCESS TO ACOUSTIC ENCLOSURES:
Provide door type openings in enclosures as required for access to items enclosed.
Provide openings for inlet and discharge ductwork and for connections as indicated.
Provide angle flange connections for mating to ductwork and equipment.

3040 SUPPORTS:
Supply steel section supporting frames or brackets where silencers are fixed to the walls of air chambers.

3050 ACOUSTIC LININGS:
Where personnel access is provided, protect acoustic linings to prevent damage.

3060z 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.

3070z SOUND INSULATION MEASUREMENTS:

Measure sound insulation of building elements in accordance with the relevant parts of BS EN ISO 16283 as appropriate.

10000 NES

Based on version NES Y45 text March 19

Y46 – Grilles/ Diffusers/ Louvres

1011 PERFORMANCE:

Air Supply

Unless detailed otherwise elsewhere in this specification, schedules or drawings, the maximum mean air velocity in the occupied zone shall comply with category B thermal environment in accordance with BS EN ISO 7730 (PPD<10%) table A5.

eg for offices and other mainly sedentary spaces : Cooling 0.19m/s; Heating 0.16m/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 and ensure louvres are tested in accordance with BS EN 13030 and are the subject of on-going factory production control auditing. Performance classes to BS EN 13030 are as scheduled in Y46sch1.

1020z SIZE / FIXINGS GENERALLY

All sizes indicated are 'nominal'. Provide site dimensions of all louvres, diffusers and grilles before manufacture. Ensure integration and co-ordination with ceiling details, other drawings and with ceiling grid site setting out as indicated on the architects drawings.

1030 NOISE LEVELS:

Ensure sound power levels or room NR / NC 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 despatch to site.

1035 TESTING:

Manufacturer's catalogue / selection data to be based on laboratory testing / rating of air terminal devices in accordance with the following standards as appropriate to the particular types of devices to be installed:

BS EN 12238 - aerodynamic testing, mixed flow under isothermal conditions

BS EN 12239 - aerodynamic testing, low velocity for displacement applications under non-isothermal conditions

BS EN 16445 - aerodynamic testing, mixed flow under non-isothermal conditions

Provide air terminal devices tested in accordance with, BS EN ISO 5135 for determination of sound power levels

Comply with BS EN 13030 for performance testing of louvres subjected to simulated rain.

Where mock up testing is required, measure air velocity / flow rates, temperatures and sound pressure levels in accordance with BS EN 15726. Refer to schedule Y51sch1.

1041 ELECTRICAL BONDING TERMINAL:

Ensure an electrical bonding terminal suitable for connection of a bonding conductor with cross-sectional areas in the range 2.5mm^2 to 10mm^2 is provided on metal grilles, diffusers and louvres where indicated.

2000 PRODUCTS/MATERIALS

2009 MOUNTING:

Grilles

Flanged screw fixings - Used on the following grille types: fixed blade, adjustable blade, egg crate, non-vision

Concealed fixings - Used on the following grille types: mesh, linear

unless otherwise indicated

Diffusers

Flanged screw fixings - Used on the following diffuser types: punkah louvre

Hidden screw fixing - Used on the following diffuser types: circular, linear, straight line fixed louvre

Rear suspension brackets - Used on the following diffuser types: perforated face, adjustable curved blade, straight line fixed louvre, high induction, laminar flow panel

Internal concealed fixings - Used on the following diffuser types: linear lighting/air module, straight line fixed louvre
Hidden bayonet fixing - Used on the following diffuser types: extract/exhaust valve unless otherwise indicated

Louvres
Side screw fixings.
or Rear angles or cleats.
or As otherwise 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 or drawings.
Fix blades at an angle to the horizontal
Grilles to be complete with Allen key operated opposed blade damper unless scheduled otherwise.

2020A GRILLES - ADJUSTABLE BLADE TYPE:
N/A

2030A GRILLES - MESH TYPE:
N/A

2040z GRILLES - EGG-CRATE TYPE:
Core material - Aluminium or plastic or as otherwise indicated.
Style – With frame or as otherwise indicated.

2042 GRILLES - SECURITY TYPE:
N/A

2050 GRILLES - LINEAR TYPE:
N/A

2060A GRILLES - FLOOR TYPE:
N/A

2070A TRANSFER GRILLES - SIGHTPROOF NON-VISION TYPE:
N/A

2070B TRANSFER GRILLES - LIGHTPROOF NON-VISION TYPE:
N/A

2070C TRANSFER GRILLES - FIRE RESISTANT NON-VISION TYPE
N/A

2070D TRANSFER GRILLES - FIRE RESISTANT NON-VISION TYPE WITH SMOKE CONTROL FACILITY:
N/A

2070E TRANSFER GRILLES - ACOUSTIC TYPE TO REDUCE CROSS TALK:
N/A

2080A CONE TYPE CIRCULAR DIFFUSERS:

Supply circular diffusers manufactured to ensure rigid and smooth outer cone or frame, and inner assembly.

Space all cones to ensure even distribution of air flow with minimum resistance and noise, and to allow easy cleaning.

Cone type

Fixed or adjustable deflection cone type as indicated. Inner assembly to move vertically by vertical sliding action or rotation.

2080B PLAIN FACE OR PAN TYPE CIRCULAR DIFFUSERS:

Supply circular diffusers manufactured with a smooth circular adjustable face plate to give a 360° air pattern and inner adjustable control disc assembly.

2090A DIFFUSERS - LINEAR SLOT TYPE:

N/A

2090B DIFFUSERS - HIGH INDUCTION BARREL SLOT TYPE:

N/A

2100 DIFFUSERS - PERFORATED FACE TYPE:

seal N/A

2110A ADJUSTABLE CURVED VANE DIFFUSER:

N/A

2130B FIXED LOUVRE LINEAR DIFFUSER WITH REMOVABLE CORE:

N/A

2140A JET AIR NOZZLE DIFFUSERS:

N/A

2140B DRUM JET TYPE DIFFUSERS:

N/A

2140C JET TYPE NOZZLE WITH SWIRL UNIT:

N/A

2140D JET DIFFUSERS WITH REVERSIBLE / ROTATABLE CORE:

N/A

2150 DIFFUSERS - LINEAR LIGHTING/AIR MODULAR TYPE:

N/A

2160 LAMINAR FLOW PANELS:

Supply laminar flow panels suitable for use in clean rooms, laboratories and operating theatres. N/A

2170B HIGH INDUCTION SWIRL DIFFUSERS:

N/A

2172A CIRCULAR SWIRL FLOOR MOUNTED DISPLACEMENT DIFFUSERS:

N/A

2174A WALL OR FREE STANDING LOW VELOCITY DISPLACEMENT DIFFUSERS:

Unless scheduled otherwise, units to be complete with galvanised steel perforated front panel, N/A

2174B FLOOR MOUNTED LOW VELOCITY DISPLACEMENT DIFFUSERS:
N/A

2180DIFFUSERS - SUPPLY/EXHAUST VALVE TYPE:
Supply diffusers incorporating intake ring and adjustable valve disc assembly.
Provide bayonet type fixing for purpose made mounting ring with plastic foam sealing gasket.
Provide setting template.
Spinning disc to be powder coated steel.
Adjust valve to required setting and lock valve in required position.

2185 FABRIC AIR DUCT DISTRIBUTION DEVICES:
N/A

2190A LOUVRES - EXTERNAL AIR SUPPLY/EXTRACT TYPE:
Provide louvres which have been tested in accordance with BS EN 13030, and which are the subject of ongoing factory production control auditing.
Performance and classification to BS EN 13030
Ensure louvres perform to water penetration class at a face / core velocity as scheduled.
Ensure louvres achieve a coefficient of discharge class as scheduled.
Construction
Construct louvre frame and aerodynamically profiled louvre blades from galvanized mild steel or aluminium.
Provide integral drainage channels.
Retain infill on louvre blades by perforated sheet of galvanized mild steel or aluminium.
Screen
Fit a bird-screen using mesh no coarser than 12mm, across inside face of louvres.
Fit an insect-screen using mesh no coarser than 3mm, across inside face of louvres only where scheduled.
Quality assurance
Ensure manufacturers are a firm of Assessed Capability to BS EN ISO 9001 and produce louvre to relevant Quality Assessment schedule.
Installation
Install louvres strictly in accordance with the manufacturer's instructions.

2200 LOUVRES/SCREEN WALLING:
N/A

2210A GALVANISED STEEL:
Galvanize steel in accordance with BS EN 10346, or BS EN 10143 and

2210B ALUMINIUM:
Use aluminium sheet/extruded aluminium produced to relevant parts of BS EN 485, BS EN 515, and BS EN 573 or relevant parts of BS EN 755

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.

Finish
Powder coat finish to an RAL colour specified as indicated or specified by the Architect.

2230A LOUVRE CONSTRUCTION:
Ensure louvres are robust. Incorporate in purpose made sub-frame. Provide drip sills.

2252 ACOUSTIC LOUVRES: (NES Y45 2120B)
N/A

3000 ACCESSORIES

3010A OPPOSED BLADE VOLUME CONTROL DAMPERS:
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 the damper blades through face or side of grille/diffuser as indicated.
Remote blade operation
Supply and install proprietary remote control unit with all necessary brackets and linkage at the control unit. Provide label at the control unit to indicate function.

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.

3051 `IRIS' TYPE 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.
Operation
By loose key, unless otherwise indicated.

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.

3060B ADJUSTABLE 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.

3080 PERFORATED BAFFLE PLATES:
Cover full width or depth of plenum box and extend beyond each side of air inlet to ensure even air distribution. Position centrally relative to plenum box air inlet.

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.

3100 CEILING OR WALL MOUNTED PLENUM BOXES:
Supply single plenum box or series of plenum boxes butted together to form continuous length, as indicated. Ensure sturdy and rigid construction with circular inlet spigots 65mm minimum length.
Incorporate at least four drilled angle brackets, or flat bar lugs, for securing to, or suspension by rods or wires from building or other construction.

3110 FLOOR MOUNTED PLENUM BOXES:
N/A

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.

3130z SPARES:
Supply 5 loose keys, suitable for adjusting each size and type of grille, or operating accessories.

4000 WORKMANSHIP

4010 GRILLE/DIFFUSER LOCATION:

Fit at terminal air supply, extract and transfer points indicated, in accordance with the manufacturers' recommendations and HEVAC Guide to Air Distribution Technology for the Internal Environment.

4020 LOUVRE LOCATION:
Fit at system main air intake and discharge points, as indicated.

4030 ACCESSORIES:
Supply all grilles, diffusers etc with OBDs unless indicated otherwise. Fit other accessories to each grille and diffuser in accordance with manufacturer's instructions and as indicated.

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.

4050z INSTALLATION IN BUILDERSWORK:
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 pressurized rooms to voids above.
Fix louvres to building fabric in accordance with the manufacturers' recommendations using face flange.
or Building in lugs.
or Rear studs.
or Masonry frame - supply only for fixing by others.
or As otherwise indicated.

4060A TRANSFER GRILLES:
Where transfer points are located in partitions or walls, prevent through vision by fitting a fixed blade grille on both faces of partition or wall. Connect cavity wall or partition transfer grille assemblies with ducting sleeve or collar extending between grilles.

4060B TRANSFER GRILLES WITH FIRE DAMPER OR WITH FIRE DAMPER + SMOKE CONTROL DAMPER

N/A

4070 INSTALLATION OF FABRIC AIR DUCT DISTRIBUTION DEVICES:
N/A

4075 FIXING:
Provide details of fixing method for all grilles, diffusers, louvres and other terminal devices for approval.

10000 BASED ON NES Y46 Dec 19

Y50 – Thermal Insulation

1000 GENERAL

1010 TEMPERATURE RANGE:

Refer to insulation manufacturer's recommendations to determine suitability of different insulation materials at different temperature ranges.

1021 STANDARDS:

All thermal insulation and methods of application shall comply with the requirements of the current version of British Standards, Codes of Practice Building Regulations including but not limited to:-

Relevant parts of BS 476, , BS EN 13166, BS 3958, BS 5422, BS 9999, BS 5608, BS 5970, BS 7572, relevant parts of BS EN 13941and BS EN ISO 12241 as appropriate to the project particular requirements.

For product clauses comply with BS EN 14303, BS EN 14304 and BS EN 14314

Latest edition of Building Regulations Part L Approved Documents and the following 2nd tier documents:

Non domestic and domestic building services compliance guides.

TIMSA HVAC compliance guide.

Description of terms as BS 3533.

Use insulating materials that comply with EU Regulation 517/2014 fluorinated greenhouse gases.

Use insulating materials that comply with EC Regulation 1005/2009 on substances that deplete the ozone layer.

All insulation products must have a Declaration of Performance (DoP) certificate and be CE marked in accordance with the Construction Products Regulations 2013 (CPR).

Comply with BS EN 16783 and BS EN 15804 in preparing environmental product declarations (EPD's)

1031 MATERIALS:

All insulation materials, adhesives and finishes in compliance with BS 476-4 , non-combustion test; or obtain a Class 'O' fire rating to Building Regulations to BS 476-6 and 7 and shall not be flammable or support combustion.

Materials classified according to BS EN 13501-1 (ref clause Y50.1036) shall not show propensity for continuous smouldering combustion when tested in accordance with BS EN 16733

Ensure metals and materials that cause galvanic corrosion are not installed in contact. Do not use galvanised or zinc coated steel jacketing and accessories on austenitic stainless steel or nickel steel/alloy equipment and piping.

Comply with the CLP regulation 2015 (European Regulation EC 1272/2008)

All insulation materials shall be:-

- Inherently proof against rotting, mould and fungal growth and attack by vermin.
- Non-hygroscopic and in all respects be suitable for continuous use throughout the range of operating temperatures and within the environment indicated.
- Wholly compatible with the material it is insulating at the design working temperature and environmental conditions.
- Free from chemicals which may contribute to corrosion or degradation of the insulated surface or finish.
- Comply with the Health & Safety at Work Act and COSHH Regulations and be non carcinogenic.
- Asbestos Free. (Where any work is carried out on existing thermal insulation material or finish which contains asbestos in any form, attention is drawn to responsibilities under the provisions of the Control of Asbestos Regulations 2012).
- First class quality new materials delivered to site fully dried out and housed in dry store until ready for use.

For all mineral wool insulation products, test evidence must be available showing

that the fibres from which the products are made are not classified as a possible human carcinogen.

Use insulating materials with a Global Warming Potential (GWP) of less than 5.

Use insulating materials with an Ozone Depletion Potential (ODP) of zero.

1036 EUROPEAN CLASSIFICATION FOR REACTION TO FIRE PERFORMANCE:

Supply insulating materials classified in accordance with BS EN 13501-1 Fire classification of construction materials. Classes acceptable are A1 / A1L, A2 / A2L or B / BL having smoke emission classification of s1 (materials that give off little or no smoke) and production of flaming droplets/particles classification of d0.

Test methods

BS EN ISO 1182, BS EN ISO 1716, BS EN ISO 11925-2 BS EN 13823 as appropriate.

1045 CONTROL OF FIBRE MIGRATION:

Ensure all mineral wool type materials are fully wrapped with foil cover and sealed with tape to stop fibre migration.

1051 SPREAD OF FLAME:

When completed, ensure surface-finish complies with BS 476-7 Class 1 spread of flame, unless otherwise indicated.

1052 PRE-INSULATED PIPELINES AND AIR DUCTLINES:

In locations where insulation cannot be installed after erection of pipelines or air ductlines pre-insulated sections shall be installed. Insulation to such sections shall be equivalent in thermal and physical properties to that specified for the remainder of the system. Where vapour barriers are provided their integrity shall be maintained over the pre-insulated sections and the junctions to the remainder of the system.

1055 SMOKE EMISSION CHARACTERISTICS:

Ensure only products classified by BS EN 13501-1 as s1 (materials that give off little or no smoke) are used.

1060 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.

1070 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.

1081 ELECTRICAL BONDING:

Ensure an electrical bonding connection of 6-mm^2 conductor is provided where required to maintain electrical continuity.

1091 INSPECTION AND TESTING:

Where indicated 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.

Provide assistance to allow for inspection of all sizes of insulation on all services after installation to determine thickness and compliance with specification. Make good any sections that are cut during inspection for thickness and compliance with specification.

2000 PRODUCTS/MATERIALS

Y50 – Thermal Insulation

2010 THERMAL CONDUCTIVITY:

All thermal conductivity figures given in insulation product clauses are typical values at the mean temperature stated, as declared in manufacturers Declaration of Performance (DoP) certificates in accordance with the CPR.

2016 THERMAL PERFORMANCE LIFE EXPECTANCY

Ensure the insulation will maintain its thermal performance for a minimum of the plant design life and provide manufacturers details which define the life expectancy of the insulation material. The Lambda value of the insulation should also be quoted at both manufactured and aged value in accordance with BS EN 14314 for phenolic foam products.

2021 RESTRICTIONS ON USE OF MATERIAL:

Protect insulated stainless steel surfaces from the risk of stress corrosion in accordance with the recommendations in BS 5970.

Do not install insulants with man-made mineral fibres in food preparation areas or aseptic areas. For all mineral wool insulation products, test evidence must be available showing that the fibres from which the products are made are not classified as a possible human carcinogen, as detailed by European Directive 97/69/EC and the Approved Supply List of CHIP98 and that the fibres should be bio-soluble.

2030 ROCK or GLASS MINERAL WOOL PIPE INSULATION:

Standard - BS EN 14303
Nominal density 120 kg/m^3
Thickness 20mm to 100mm
Thermal conductivity
Rock Wool - Typical value of 0.033-0.034W/mK at a mean temperature of 10°C
Glass Wool – Typical value of 0.033 W/mK at a mean temperature of 10°C
Finish -Reinforced aluminium foil with at least 25mm overlap.

2040 MINERAL WOOL RIGID DUCT INSULATION:

Standard - BS EN 14303.
Type – Rock or glass
Nominal density - 45 - 48 kg/m$^{3.}$
Thickness - 25mm to 100mm.
Thermal conductivity - - Typical value of 0.033 - 0.034W/mK at a mean temperature of 10°C
Finish- Reinforced aluminium foil

2050 MINERAL WOOL FLEXIBLE DUCT INSTALLATION:

Standard - BS EN 14303.
Type – Rock or glass
Nominal density 28- 45 kg/m^3
Thickness - 25mm to 60mm
Thermal conductivity - Not exceeding 0.033 - 0.034 W/mK at a mean temperature of 10°C
Finish -Reinforced aluminium foil

2060 ROCK OR GLASS MINERAL WOOL LAMELLA OR CRIMPED MAT DUCT INSULATION:

Standard - BS EN 14303.
LAMELLA
Nominal density –24 - 45 kg/m3.
Thickness - 25mm to 80mm.
Thermal conductivity
Typical value of 0.04 W/mK at a mean temperature of 10°C
Finish - Reinforced aluminium foil.
The Lamella duct insulation must be factory produced, by the mineral Wool manufacturer, 'on line' in one continuous process and not converted as a separate production process.

CRIMPED MAT
Nominal density – 25 to 45 kg/m3
Compression resistance - Maximum of 13% compression at a static load of 2 kPA,.
Thickness - 25mm to 80mm.
Thermal conductivity
Typical value of 0.039 W/mK at a mean temperature of 50°C
Finish - Reinforced aluminium foil.

2111 CLOSED CELL RIGID PHENOLIC FOAM (PF) PREFORMED SECTIONS - CFC AND HCFC FREE:

Standard - BS EN 14314 Nominal density - 35 - 40 kg/m^3.
Temperature range - -180° to +120°C.
Thickness - 15mm to 50mm.

Thermal conductivity
Typical value of 0.025 W/mK at a mean temperature of 10°Cwhen fully aged in accordance with BS EN 14314.
Finish
Reinforced aluminium foil or manufacturer's standard matt black as scheduled.
All phenolic foam sections shall have been completely treated, at the insulation manufacturer's works, with a suitable dust suppressant, acid neutralising and passivating coating. Also, all exposed edges of phenolic foam insulation shall be sealed to the surface being insulated with a suitable vapour sealing mastic

2121 CLOSED CELL RIGID LAMINATED PHENOLIC FOAM (PF), DUCT INSULATION SLAB - CFC AND HCFC FREE:

Standard - BS EN 14314 Nominal density - 40 kg/m^3.
Thickness - 20mm - 50mm
Thermal conductivity
Typical value of 0.022 W/mK at a mean temperature of 10°C when fully aged in accordance with BS EN 14314.

2131 HIGH DENSITY PHENOLIC PIPE AND DUCT SUPPORT FOAM - CFC AND HCFC FREE

Standard - BS EN 14314
Nominal density - 80 kg/m^3 to 120 kg/m^3.
Temperature range - 180°C to +120°C.
Thermal conductivity
Typical value of 0.045 W/mK at a mean temperature of 50°C. when fully aged in accordance with BS EN 14314.

2140 CLOSED CELL NITRILE AND EPDM RUBBER ELASTOMERIC SHEET AND PREFORMED FLEXIBLE SECTIONS CFC/HCFC FREE AND ZERO ODP/GWP:

Standard BS EN 14304
Nitrile rubber
Nominal density - 45 - 100 kg/m3.
Temperature range - 50°C to +110°C
Thickness
Sections
6mm to 32mm for pipe sizes 6mm to 114mm.
Sheets - 6mm to 50mm.
Thermal conductivity
Typical value of 0.036 W/mK at a mean temperature of 20°C.
EPDM rubber
Nominal density - 45 - 100 kg/m3.
Temperature range - -50 to +150oC
Thickness
Sections - 10mm to 25mm for pipe sizes 10mm to 89mm.

Sheets - 10mm to 32mm.
Thermal conductivity - Typical value of 0.045 W/mK at a mean temperature of 40°C.

2170 VAPOUR BARRIER PERMEANCE:
Comply with requirements of BS 5422 and BS 5970.
Maximum permitted water vapour permeance in relation to plant temperature at an ambient temperature of +20°C (dry bulb) to be in accordance with BS 5422, Table 1.

2185 ACOUSTIC INSULATION:
Where indicated provide acoustic insulation.
Refer to Y45 clause 2090z for technical details and schedule Y45sch for locations / systems.

2190 ADHESIVES
Comply with the recommendations of clause 10.1 of BS 5970 for insulation bonding adhesives; lagging adhesives; and facing and film attachment adhesives.

2195 FIRE PROTECTION CLADDING
Where indicated, ductwork shall be provided with a proprietary fire protection cladding material as described below.

The fire protection material and all ancillary fixing products shall be shown as a system (by independent test) to meet the requirements of BS EN 1366-1 in the case of supply and extract ventilation systems and classified in accordance with BS EN 13501-3.
In the case of smoke extract / fire ventilation the system shall meet the requirements of BS EN 1366-1 and BS EN 1366-8 or BS EN 1366-9 and classified in accordance with BS EN 13501-4.
For kitchen extract ducting systems it shall be shown by test or assessment by an independent 3rd party to meet the requirements BS 476-24 or BS EN 1366-1 and classified in accordance with BS EN 13501-3.
In each case the criteria as defined in the above test standards of stability, integrity and insulation shall each be achieved fully for the required period of protection as scheduled or described in the particular specification.

Generally all ducts shall be protected on all four sides. Where an adjacent slab or wall is conveniently placed to form one side of the enclosure this may be utilised subject to its fire rating being as that of the required enclosure being adequately connected and sealed to the wall or slab, and subject to agreement by the Engineer.

The following proprietary constructions are acceptable and represent the minimum required. All material thicknesses, adhesives and final installation and the underlying ductwork shall in all ways comply with the requirements of the Manufacturers material and installation instructions, Building Regulations and the Buildings Control officer to suit the scheduled period of fire protection and whether ducts are exposed internal or external fire or both.

Promat "Vicuclad" 430 kg/m^3 Board Cladding – (where ducts are required to be protected, the ducts shall initially be encased with mineral rock Wool slabs having a minimum density of 60kg/m^3 or 80kg/m^3)
Rockwool “Fire Duct” 160 kg/m^3 Ductwork slab rigid Insulation Fire Protection Board Cladding
Saint - Gobain Isover “Ultimate-Protect” 66 kg/m^3 slab and flexible wired mat.

2201 POLYISOBUTYLENE PROTECTION:
Polyisobutylene - minimum thickness 0.8mm.

2202 PVC PROTECTION:
Rigid PVC - thickness 0.35mm.

2203 ALUMINIUM SHEETING PROTECTION:
Apply flat (embossed)or profiled aluminium cladding directly to insulating material, thickness, 0.56mm on pipework, 0.71mm on ductwork

2204 ALUMINIUM-ZINC COATED STEEL PROTECTION:
Mild steel sheet continuously hot dipped with 185gm aluminium-zinc coating to BS EN 10326 and BS EN 10327 applied directly to insulating material.
0.4mm thick flat sheet. Installation shall be in accordance with the manufacturers recommendations.

2205 SELF ADHESIVE WEATHER RESISTANT ZERO PERM MULTI-LAYER LAMINATE FOIL/FILM PROTECTION:

N/A

2211 REINFORCEMENT:
Use one of the following methods where reinforcement is required.

Galvanized wire netting - comply with BS EN 10223, not less than 0.9mm diameter wire, 25mm mesh (50mm mesh on ductwork).

or Galvanized wire -not less than 0.9mm diameter wire, spirally wound at 75mm pitch.

or Aluminium bands - not less than 20mm wide x 0.5mm thick with galvanized wire end loops, at 300mm centres.

2221 VALVES, ANCILLARIES AND FLANGE INSULATION:
Install insulation on all flanges and valves and other pipeline ancillaries. The only exception is on valves and pipeline ancillaries on hot services smaller than 32mm on internal applications where the heat loss can be demonstrated as “always useful”. (Where un-insulated valves or ancillaries could cause a safety hazard, they shall be insulated)

Use a protected metal split casing fabricated from 1.2mm aluminium sheet fitted with spring clip fasteners, filled with insulating material with same thermal performance as insulation on adjoining pipe.

or Use moulded insulation boxes filled with insulating material with same thermal performance as insulation on adjoining pipe.

or Use proprietary flexible insulation jackets manufactured from aluminised glass cloth, with a minimum of 50mm mineral Wool infill fastened with Velcro and draw cord fastening.

Valve boxes shall include removable covers over handwheels and stems, comply as appropriate with BS 5970. Additionally, on cold applications, wrap cold piping valve bodies and flanges with 50mm thick flexible material with facing and seal joints to maintain vapour barrier.

2225 DUCTWORK FLANGE INSTALLATION
Insulation thickness should be selected such that a minimum thickness is carried over flanges and/or stiffeners for continuation of vapour barrier and/or sufficient insulation to avoid condensation.

2231 PROTECTION FOR HEAT EXCHANGERS AND OTHER VESSELS WITH CHEST COVERS:
N/A

2241 INSULATION FOR BOILER FLUES, MINERAL WOOL, ALUMINIUM BANDS:
N/A

2250 PRE-INSULATED BOILER FLUES:
N/A

2260 PRE-INSULATED STORAGE VESSELS:
Ensure insulation standards on pre-insulated storage vessels meet the general specification requirements of the works.

2270 CYLINDER JACKETS:
N/A

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2281 PUMPS AND OTHER IRREGULAR SHAPES:
All pumps, heat exchangers and other irregular shapes shall be insulated to prevent condensation. All heat exchangers and other pipeline ancillary components shall be insulated to control heat loss. Where access is required to pumps and other irregular shapes submit proposals for materials and methods of applying a demountable finish, for approval.
Comply with requirements of BS 5970.

2285 THICKNESS OF INSULATION:
Supply thickness of insulation as indicated. For HWS pipework trace heated for temperature maintenance refer to clauses 2291 and 2301 and schedule Y24.
Where a material with an alternative thermal conductivity (k factor) is offered, utilise a thickness which will provide an equivalent degree of insulation to the combination of thickness and k factor specified. The figures are derived from the tables given in BS 5422 and the calculation methods given in BS EN ISO 12441.

2286 CALCULATION OF INSULATION THICKNESS - BUILDING REGULATIONS:
Provide insulation of thickness conforming with the requirements of the Building Regulations (England and Wales) Part L Approved Documents or the Scottish Technical Handbooks, and the calculation methods given in BS EN ISO 12241 using the standardised assumptions within table C1 of BS 5422.

2287 CALCULATION OF INSULATION THICKNESS - ECA ENHANCED:
The insulation manufacturer selected for a particular project should calculate the minimum required thicknesses of pipework insulation based on the actual conductivity of the product at the relevant temperature and the criteria on the ECA web site for an eligible installation using the methodology set out in BS EN ISO 12241 and the assumptions set out in Table C1 of BS 5422.

2289 INSULATION THICKNESS TABLES AND PIPE SIZES:
Unless stated otherwise the thicknesses given in the tables in this specification are the nearest commercially available material thickness to meet the minimum calculated thickness to BS ISO 12241 and the product declared performance data for CE marking. Thicknesses have been calculated by manufacturers for each product and use thermal conductivity values calculated from the mean insulation temperature based on the fluid and air temperatures listed in the relevant tables.
Should alternative products be offered that may have different performance data the Contractor shall ensure the manufacturer undertakes calculations and submits appropriate thickness table.
For HWS pipework trace heated for temperature maintenance refer to clauses 2291 and 2301 and schedule Y24.
Unless specified otherwise elsewhere, the thicknesses for pipe of greater diameter, flat surfaces or irregular shaped plant items shall not be less than that for the largest pipe size given in the thickness tables
Most tables give steel pipe sizes as OD, equivalent nominal bore sizes are given below

Approx. OD (mm)	Nominal bore	Approx. OD (mm)	Nominal bore
17	10	140	125
21	15	165	150
27	20	219	200
34	25	273	250

42	32	324	300
48	40	356	350
60	50	406	400
76	65	457	450
89	80	508	500
114	100	610	600

2291 NON DOMESTIC HOT WATER SUPPLY SERVICES THICKNESS TABLE BUILDING REGULATIONS: ROCK & GLASS MINERAL WOOL:

Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide, Northern Ireland Technical Booklet F2 and Section 6 of the Scottish Non Domestic Technical Handbook.

Outside diameter of steel pipe (mm)	Thickness of rock mineral wool (mm)		Thickness of glass mineral wool (mm)	
Surface emissivity	0.05	0.9	0.05	0.9
17	25	30	25	30
21	25	30	25	30
27	30	35	30	40
34	30	35	30	40
42	30	35	30	40
48	35	40	40	40
60	40	40	40	40
76	35	45	40	40
89	35	45	40	40
114	40	45	40	50
140	40	45	40	50
168	40	50	40	50
219	40	50	40	50
273 and above	45	50	40	50

Basis: Horizontal pipe at 60°C in still air at 15°C, thermal conductivity values calculated from the mean insulation temperature based on the fluid and air temperatures.
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.
For trace heated HWS pipework for temperature maintenance, the thicknesses shall be adjusted (as advised by the trace heating specialist) to ensure the correct combination of thermal insulation (thermal conductivity / thickness) and heating cable (ie output / straight or double or spiral) to meet the design parameters in schedule Y24.

2305 NON DOMESTIC HOT WATER SUPPLY SERVICES BUILDING REGULATIONS PHENOLIC FOAM

Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide, Northern Ireland Technical Booklet F2 and section 6 of the Scottish Non Domestic Technical Handbook.

Outside diameter of steel pipe (mm)	Thickness of phenolic foam (mm)	
Surface emissivity	(0.05)	(0.9)
17	15	15
21	15	20
27	15	20
34	20	20
42	20	20
48	20	25

60	20	25
76	25	25
89	25	25
114	25	30
140	25	30
168	25	30
219	30	30
273 and above	30	30

Basis: Horizontal pipe at 60°C in still air at 15°C, aged k value. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Thicknesses of nitrile rubber are minimum calculated thicknesses
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 insulated. The thicknesses may vary for other ratings.

For trace heated HWS pipework for temperature maintenance, the thicknesses shall be adjusted (as advised by the trace heating specialist) to ensure the correct combination of thermal insulation (thermal conductivity / thickness) and heating cable (ie output / straight or double or spiral) to meet the design parameters in schedule Y24

2306 NON-DOMESTIC HOT WATER SERVICE AREAS, BUILDING REGULATIONS - NITRILE RUBBER:

Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide, Northern Ireland Technical Booklet F2 and section 6 of the Scottish Non Domestic Technical Handbook.

Outside diameter of steel pipe (mm)	Approx. thickness of nitrile rubber (mm)	
Surface emissivity	(0.05)	(0.9)
17	26	31
21	28	33
27	30	35
34	32	37
42	33	38
48	35	41
60	36	42
76	38	44
89	38	44
114	39	45
140	40	47
168	41	48
219	41	48
273 and above	42	49

Basis: Horizontal pipe at 60°C in still air at 15°C. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Thicknesses of nitrile rubber are minimum calculated thicknesses.
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.

2307 NON-DOMESTIC HOT WATER SUPPLY SERVICES, ECA ENHANCED:
N/A

2308 DOMESTIC HOT WATER STORAGE VESSELS IN NEW AND EXISTING BUILDINGS- ROCK MINERAL WOOL:

Provide insulation thicknesses to limit heat losses from DHW storage vessels to the maximum recommended in Table 27 in the Non-domestic Building Services Compliance Guide (NDBSCG):2013.
Minimum thickness of insulation for vessels of capacity less than those in the table below to be 80mm.
Insulation thickness for vessels with capacity greater than $2m^3$ to be 120mm.
Install insulation in accordance with the manufacturer's recommendations.
Encase insulation in 1.6mm thick galvanised mild steel sheets.

Nominal Capacity (litres)	Typical vessel Diameter (m)	Typical vessel Height or length(m)	Maximum Heat Loss (kWh/24h)	kW	W/m^2	Rock mineral wool slab thickness mm
700	0.675	1.750	4.1	0.171	38.6	80
800	0.750	1.950	4.3	0.179	32.7	90
900	0.800	2.000	4.5	0.188	31.1	100
1000	0.850	1.950	4.7	0.196	30.9	100
1200	0.900	2.100	4.9	0.204	28.3	100
1500	1.050	1.950	5.1	0.213	26.0	110
2000	1.050	2.500	5.2	0.217	21.7	120

Basis of table: Part of Table 27 in NDBSCG:2013, rock mineral wool slabs (plain, without foil facing) conforming to BS EN 14303, $45Kg/m^3$ and thermal conductivity of 0.042W/mK at 50°C mean temperature.

2311 NON DOMESTIC HEATING SYSTEMS BUILDING REGULATIONS [INTERNAL PIPEWORK] ROCK MINERAL WOOL

Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide Northern Ireland Technical Booklet F2, and section 6 of the Scottish Non Domestic Technical Handbook.

Outside diameter of steel pipe (mm)	Thickness of rock mineral wool insulation (mm)					
Temperature of contents °C	≤95		96-120		121-150	
Surface emissivity	0.05	0.9	0.05	0.9	0.05	0.9
17	25	30	25	30	25	30
21	30	35	30	35	30	35
27	35	40	40	45	40	45
34	35	40	45	55	55	55
42	35	40	55	60	65	70
48	40	45	55	60	70	75
60	40	45	60	65	75	80
76	45	50	60	65	80	90
89	45	50	65	70	80	90
114	50	55	65	75	90	100
140	50	55	70	75	100	100
168	50	55	70	80	100	100

219	50	60	75	80	100	120
273 & above	50	60	75	90	110	120

Basis of calculation of thicknesses: Horizontal pipe at 75 °C (LTHW) or 100 °C (MTHW) or 125 °C (HTHW) in still air at 15 °C. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Use this table for insulation thickness of copper or plastic pipework of the nearest equivalent outside diameter.

2312 NON DOMESTIC HEATING SYSTEMS [EXTERNAL PIPEWORK] MINERAL WOOL INSULATION LOW EMISSIVITY OUTER SURFACE (0.05):

Minimum insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide

Nominal Steel Pipe Size (bore - mm)	Temperature of contents ^{0}C
	75 (Low temperature hot water)
	Thickness of Rock mineral wool insulation (mm)
10	60
15	60
20	60
25	60
32	60
40	70
50	70
65	70
80	70
100	70
125	70
150	70
200	70
250 & above	70
Flat Surfaces	70

The thicknesses tabled are the nearest commercial equivalent to calculated thicknesses based on: Horizontal pipe with water at 75^{0}C (LTHW) in still air at -5^{0}C.Use this table for insulation thickness of copper pipework of the nearest equivalent diameter.
Use this table for insulation thickness of copper pipework of the nearest equivalent diameter.

2315 NON DOMESTIC HEATING SYSTEMS BUILDING REGULATIONS [INTERNAL PIPEWORK] GLASS MINERAL WOOL

Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide Northern Ireland Technical Booklet F2, and section 6 of the Scottish Non Domestic Technical Handbook.

Outside diameter of steel pipe (mm)	Thickness of rock mineral wool insulation (mm)					
Temperature of contents °C	≤95		96-120		121-150	
Surface emissivity	0.05	0.9	0.05	0.9	0.05	0.9
17	25	30	25	30	25	30
21	30	40	30	40	30	40
27	30	40	40	40	40	40
34	40	40	50	50	50	50
42	40	40	50	50	60	60
48	40	50	50	60	60	80
60	40	50	60	60	80	80
76	50	50	60	60	80	80

89	50	50	60	80	80	80
114	50	50	60	80	80	100
140	50	60	80	80	100	100
168	50	60	80	80	100	100
219	50	60	80	80	100	100
273 & above	50	60	80	80	100	100

Basis of calculation of thicknesses: Horizontal pipe at 75 ºC (LTHW) or 100 ºC (MTHW) or 125 ºC (HTHW) in still air at 15 ºC. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Use this table for insulation thickness of copper or plastic pipework of the nearest equivalent outside diameter.

2325 NON DOMESTIC HEATING SYSTEMS BUILDING REGULATIONS [INTERNAL PIPEWORK]- PHENOLIC FOAM INSULATION:

Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide Northern Ireland Technical Booklet F2, and section 6 of the Scottish Non Domestic Technical Handbook.

Outside diameter of steel pipe (mm)	Thickness of phenolic foam insulation (mm)	
Temperature of contents °C	≤95	
Surface emissivity	0.05	0.9
17	15	15
21	15	20
27	20	20
34	20	20
42	20	25
48	25	25
60	25	25
76	25	30
89	25	30
114	30	30
140	30	35
168	30	35
219	30	35
273 &above	35	35

Basis of calculation of thicknesses: Horizontal pipe at 75 ºC (LTHW) or 100 ºC (MTHW) or 125 ºC (HTHW) in still air at 15 ºC. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Use this table for insulation thickness of copper or plastic pipework of the nearest equivalent outside diameter.

2325A NON DOMESTIC HEATING SYSTEMS [EXTERNAL PIPEWORK] PHENOLIC FOAM INSULATION LOW EMISSIVITY OUTER SURFACE (0.05):

Minimum insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide

Nominal Steel Pipe Size (bore - mm)	Temperature of contents ^{0}C
	Low temperature hot water 75^{0}C
	Thickness of phenolic foam insulation (mm)
10	30
15	30
20	35
25	35

Nominal Steel Pipe Size (bore - mm)	Temperature of contents ^{0}C Low temperature hot water 75^{0}C Thickness of phenolic foam insulation (mm)
32	35
40	40
50	40
65	45
80	45
100	45
125	45
150	50
200	50
250 & above	50
Flat Surfaces	50

The thicknesses tabled are the nearest commercial equivalent to calculated thicknesses based on: Horizontal pipe with water at 75^{0}C (LTHW) in still air at -5^{0}C.Use this table for insulation thickness of copper pipework of the nearest equivalent diameter.
Use this table for insulation thickness of copper pipework of the nearest equivalent diameter.
Basis: Aged k- value

2326 NON DOMESTIC HEATING SYSTEMS BUILDING REGULATIONS [INTERNAL PIPEWORK]- NITRILE RUBBER INSULATION:

Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide, Northern Ireland Technical Booklet F2 and section 6 of the Scottish Non Domestic Technical Handbook.

Outside diameter of steel pipe (mm)	Thickness of nitrile rubber insulation (mm)					
Temperature of contents °C	≤95		96-120#		121-150#	
Surface emissivity	0.05	0.9	0.05	0.9	0.05	0.9
17	27	31	26	29	32	35
21	31	36	32	36	38	42
27	34	39	40	45	48	52
34	36	42	47	52	59	65
42	38	44	51	57	74	81
48	40	46	52	58	77	84
60	42	48	56	62	82	89
76	44	50	59	66	87	95
89	45	52	61	67	90	98
114	47	54	65	71	96	103
140	48	55	68	74	100	107
168	49	56	70	77	102	110
219	51	58	72	79	106	115
273	51	58	74	81	109	118

Thicknesses of nitrile rubber are minimum calculated thicknesses.
Basis: Horizontal pipe at 75°C (LTHW) or 100°C (MTHW) or 125°C (HTHW) in still air at 15°C. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Use this table for insulation thickness of copper or plastic pipework of the nearest equivalent outside diameter.
for service temperatures above 110°C specialist high temperature Foamed EPDM rubber must be used as recommended by the manufacturer.

2327 NON-DOMESTIC HEATING INSTALLATIONS, ECA ENHANCED:
N/A

2331 DOMESTIC CENTRAL HEATING AND HOT WATER SYSTEMS ROCK & GLASS MINERAL WOOL INSULATION:
Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Domestic Building Services Compliance Guide Northern Ireland Technical Booklet F1, and section 6 of the Scottish Domestic Technical Handbook.

Outside diameter of copper pipe (mm)	Thickness of rock mineral wool (mm)		Thickness of glass mineral wool (mm)	
Surface emissivity	0.05	0.9	0.05	0.9
15	-	-	20	20
22	20	20	20	20
28	20	25	20	20
35	20	25	20	25
42	20	25	20	25
54	20	25	20	25

Basis of calculation: Horizontal pipe at 60^{O}C (LTHW) in still air at 15^{O}C. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Mineral wool sections are not available for pipe outside diameters less than 17mm.
Use this table for insulation thickness for plastic pipework of the nearest equivalent outside diameter.

2332 DOMESTIC CENTRAL HEATING AND HOT WATER INSTALLATIONS, ECA ENHANCED:
N/A

2336 DOMESTIC CENTRAL HEATING AND HOT WATER SYSTEMS - PHENOLIC FOAM
Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Domestic Building Services Compliance Guide, Northern Ireland Technical Booklet F1 and section 6 of the Scottish Domestic Technical Handbook.

Outside diameter of copper pipe (mm)	Thickness of phenolic foam insulation (mm)	
Surface emissivity	0.05	0.9
15	15	15
22	15	15
28	15	15
35	15	15
42	15	15
54	15	15

Basis: Horizontal pipe, water at 60°C in still air at 15°C, aged k value. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.

2337 DOMESTIC CENTRAL HEATING AND HOT WATER SYSTEMS – NITRILE RUBBER
Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Domestic Building Services Compliance Guide, Northern Ireland Technical Booklet F1 and section 6 of the Scottish Domestic Technical Handbook.

Outside diameter of copper pipe (mm)	Thickness of nitrile rubber insulation (mm)

Surface emissivity	0.05	0.9
8	9	9
10	13	13
12	13	19
15	19	19
22	19	25
28	19	25
35	25	25
42	25	25
54	25	32

Basis: Horizontal pipe, water at 60°C in still air at 15°C, aged k value. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.

2340 STEAM AND CONDENSATE SYSTEMS FOR HVAC SYSTEMS - ROCK MINERAL WOOL:

N/A

2395 COOLED WATER SUPPLIES, BUILDING REGULATIONS, HEAT GAIN AND CONDENSATION CONTROL ON COOLED AND COLD WATER SUPPLIES - ROCK MINERAL WOOL:

Insulation thicknesses are the worst case to control heat gain to maximum permissible figures stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide Northern Ireland Technical Booklet F2, and section 6 of the Scottish Non Domestic Technical Handbook and control condensation in accordance with BS 5442.

Outside diameter of steel pipe (mm)	Thickness of mineral wool insulation (mm)					
Temperature of contents °C	>10		4.9 to 10		0 to 4.9	
Surface emissivity	0.05	0.9	0.05	0.9	0.05	0.9
17	20	20	25	25	30	30
21	20	20	25	25	30	30
27	20	20	30	30	35	30
34	20	25	30	30	35	35
42	25	25	30	30	40	35
48	25	25	35	30	40	35
60	25	25	35	35	45	40
76	30	30	40	35	50	45
89	30	30	40	35	50	45
114	30	30	45	35	55	45
140	35	30	45	40	55	45
168	35	30	50	40	60	45
219	35	30	50	40	65	45
273	40	30	55	40	70	45
324	40	40	55	45	70	60
356	40	40	60	50	75	60
406	45	50	60	60	75	70
456	45	60	60	70	80	80
508	45	60	65	80	80	90
610	50	80	70	90	90	110
Flat	50	80	70	90	90	110

Basis for condensation: control ambient temperature of 25°C and a relative humidity of 80%. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.

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.

2396 COOLED WATER SUPPLIES, BUILDING REGULATIONS, HEAT GAIN AND CONDENSATION CONTROL ON COOLED AND COLD WATER SUPPLIES – GLASS MINERAL WOOL:

Insulation thicknesses are the worst case to control heat gain to maximum permissible figures stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide Northern Ireland Technical Booklet F2, and section 6 of the Scottish Non Domestic Technical Handbook and control condensation in accordance with BS 5442.

Outside diameter of steel pipe (mm)	Thickness of glass mineral wool insulation (mm)					
Temperature of contents °C	>10		4.9 to 10		0 to 4.9	
Surface emissivity	0.05	0.9	0.05	0.9	0.05	0.9
17	20	20	20	25	25	25
21	20	20	25	25	30	30
27	20	20	25	25	30	30
34	20	20	25	30	40	30
42	20	20	30	30	40	40
48	25	25	30	30	40	40
60	25	25	30	30	50	40
76	25	25	40	40	50	40
89	25	25	40	40	50	40
114	30	30	40	40	50	40
140	30	30	40	40	50	40
168	30	30	40	40	60	50
219	40	30	50	40	60	50
273	40	30	50	40	60	50
324	40	40	50	45	60	60
356	40	40	50	50	60	60
406	40	50	60	60	80	70
456	40	60	60	60	80	80
508	40	60	60	80	80	90
610	40	80	60	80	80	100
Flat	50	80	60	90	80	100

Basis for condensation: control ambient temperature of 25°C and a relative humidity of 80%. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.

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.

2411 COOLED WATER SUPPLIES, BUILDING REGULATIONS, HEAT GAIN AND CONDENSATION CONTROL ON COOLED AND COLD WATER SUPPLIES – PHENOLIC FOAM:

Insulation thicknesses are the worst case to control heat gain to maximum permissible figures stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide Northern Ireland Technical Booklet F2, and section 6 of the Scottish Non Domestic Technical Handbook and control condensation in accordance with BS 5442.

Outside diameter of steel pipe (mm)	Thickness of phenolic foam insulation (mm)					
Temperature of contents °C	>10		4.9 to 10		0 to 4.9	
Surface emissivity	0.05	0.9	0.05	0.9	0.05	0.9
17	15	15	20	15	25	20
21	15	15	20	15	25	20
27	15	15	20	20	25	20
34	20	15	25	20	30	20
42	20	15	25	20	30	25
48	20	20	25	20	30	25
60	20	20	25	25	35	25

76	20	20	30	25	35	30
89	20	20	30	25	40	30
114	25	20	35	25	40	30
140	25	20	35	25	45	30
168	25	20	35	25	45	30
219	30	20	40	30	50	35
273	30	25	40	30	50	35
324	30	25	40	30	55	35
356	30	25	45	30	55	35
406	30	25	45	30	55	35
456	35	25	45	30	60	35
508	35	25	45	30	60	35
610	35	25	50	30	65	35

Basis for condensation: control ambient temperature of 25°C and a relative humidity of 80%. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures, Aged k value.

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.

2412 COOLED WATER SUPPLIES, BUILDING REGULATIONS, HEAT GAIN AND CONDENSATION CONTROL ON COOLED AND COLD WATER SUPPLIES – NITRILE RUBBER:

Insulation thicknesses are the worst case to control heat gain to maximum permissible figures stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide Northern Ireland Technical Booklet F2, and section 6 of the Scottish Non Domestic Technical Handbook and control condensation in accordance with BS 5442.

Outside diameter of steel pipe (mm)	Thickness of nitrile rubber insulation (mm)					
Temperature of contents °C	>10		4.9 to 10		0 to 4.9	
Surface emissivity	0.05	0.9	0.05	0.9	0.05	0.9
17	15	21	20	26	23	30
21	16	22	21	27	24	31
27	17	23	23	29	2	33
34	18	25	24	31	29	36
42	19	26	25	32	30	38
48	20	27	26	33	31	39
60	20	27	27	35	33	40
76	21	28	28	37	37	45
89	21	29	29	37	37	45
114	22	30	29	37	37	45
140	22	30	30	38	37	45
168	22	30	30	39	38	47
219	22	31	30	39	38	47
273	22	31	30	39	38	47
324	25	35	30	40	40	50
356	25	35	35	40	40	50
406	25	40	35	40	45	50
456	25	40	35	40	45	50
508	25	40	35	40	45	50
610	25	40	35	40	45	50

Basis for condensation: control ambient temperature of 25°C and a relative humidity of 80%. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.

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.
Thicknesses of nitrile rubber are minimum calculated thicknesses

2372 CHILLED AND MAINS COLD WATER SUPPLIES THICKNESS TABLE [EXTERNAL PIPEWORK] To prevent condensation and control heat gain to maximum permissible figures stated in building regs part l non domestic building services compliance guide - mineral wool low emissivity outer surface (0.05):

Minimum insulation thickness with an ambient air temperature of 30^0C and relative humidity of 80%

Nominal Steel Pipe Size (bore - mm)	Temperature of contents ^{0}C			
	>10		5-10	
	Thickness of mineral wool insulation (mm)			
	Rock	Glass	Rock	Glass
10	30	30	60	50
15	30	30	60	50
20	30	30	50	50
25	40	30	50	50
32	40	40	50	50
40	40	40	50	50
50	40	40	50	50
65	40	40	50	50
80	40	40	50	50
100	40	40	50	50
125	40	40	50	50
150	40	40	50	50
200	50	50	50	60
250	50	50	50	60
300	50	50	60	60
350	50	50	60	60
400	50	50	60	70
450	50	50	60	70
500	60	60	60	70
Flat Surfaces	60	60	70	70

Use this table for insulation thickness of copper or plastic pipework of the nearest equivalent diameter. Thicknesses relate to class O rated insulation.

2420 PROTECTION AGAINST FREEZING – ROCK 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		
15	-	-
22	20	50
28	20	25
35	20	20
42	20	20
54	20	20
76	25	25
108	25	25
Steel		
21	40	-
27	20	45

34	20	25
42	20	20
48	20	20
60	20	20
76	25	25
89	25	25

Basis BS 5422 Table 29: Initial water temperature +2°C, evaluation period 12hrs thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
If mineral wool is used on pipes smaller than 20mmNB the required insulation thickness is too large to be applied in practice. To provide the appropriate degree of frost protection a combination of insulation and trace heating will be required.
Indoor condition is for ambient air temperature of -6^{o}C, permitted ice formation of 50%.
Outdoor condition is for ambient air temperature of -10^{o}C, permitted ice formation of 50%.

2421 PROTECTION AGAINST FREEZING – GLASS MINERAL WOOL:

Outside diameter of pipe (mm)	Indoor condition where freezing might occur	Outdoor condition where freezing might occur
	Thickness of glass mineral wool insulation (mm)	
Copper		
15	-	-
22	25	60
28	20	30
35	20	20
42	20	20
54	20	20
20	20	20
108	20	20
Steel		
21	50	-
27	25	40
34	20	20
42	20	20
48	20	20
60	20	20
76	20	20
89	20	20

Basis BS 5422 Table 29: Initial water temperature +2°C, evaluation period 12hrs thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
If mineral wool is used on pipes smaller than 20mmNB the required insulation thickness is too large to be applied in practice. To provide the appropriate degree of frost protection a combination of insulation and trace heating will be required.
Indoor condition is for ambient air temperature of -6^{o}C, permitted ice formation of 50%.
Outdoor condition is for ambient air temperature of -10^{o}C, permitted ice formation of 50%.

2430 PROTECTION AGAINST FREEZING - PHENOLIC FOAM:

Outside diameter of pipe (mm)	Indoor condition where freezing might occur	Outdoor condition where freezing might occur
	Thickness of closed cell phenolic foam (mm)	
Steel		
21	30	75
27	15	30
34	15	20
42	15	15
48	15	15
60	15	15
76	15	15
89	15	15
Copper		
15	35	130
22	15	30
28	15	20
35	15	15
42	15	15
54	15	15
76	15	15
108	15	15

Basis BS 5422 Table 29: Initial water temperature +2°C, evaluation period 12hrs, thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.

Indoor condition is for ambient air temperature of -6^{O}C, permitted ice formation of 50%.

Outdoor condition is for ambient air temperature of -10^{O}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 pipe (mm)	Indoor condition where freezing might occur	Outdoor condition where freezing might occur
	Thickness of closed cell nitrile rubber (mm)	
Steel		
21	54	-
27	21 25)	59
34	13(13)	31(35)
42	7(9)	17(19)
48	4(6)	10(13)
60	2(6)	6(6)
76	(6)	3(6)
89	(6)	2(6)
Copper		
15	84	-
22	18	59
28	10	31
35	6	17
42	6	10
54	6	6
76	6	6
108	6	6

Basis BS 5422 Table 29: Initial water temperature +2°C, evaluation period 12hrs, thermal conductivity values calculated from the mean insulation temperature based on the fluid and air temperatures.

If nitrile runner is used on pipes smaller than 20mmNB for the outdoor condition, the required insulation thickness is too large to be applied in practice. To provide the appropriate degree of frost protection a combination of insulation and trace heating will be required.
Figures (xx) are nearest commercially available material thicknesses. Greater thicknesses to be achieved by layering of insulation.

Indoor condition is for ambient air temperature of -6^{o}C, permitted ice formation of 50%.

Outdoor condition is for ambient air temperature of -10^{o}C, permitted ice formation of 50%.
Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter.

2456 INSULATION THICKNESS ON DUCTWORK, BUILDING REGULATIONS:

Insulation thickness to limit heat gains and heat losses stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide, Northern Ireland Technical Booklet F2 and section 6 of the Scottish Non Domestic Technical Handbook.

Material	Thickness of insulation (mm)					
	Warm air ductwork			Chilled air / dual purpose ductwork		
Surface Emissivity	Low (0.05)	Med (0.44)	High (0.9)	Low (0.05)	Med (0.44)	High (0.9)
Rock Mineral wool (Ductwrap)	40	40	40	50	60	70
Glass mineral wool	40	40	40	50	60	60
Phenolic foam	20	25	25	35	40	40
Nitrile rubber	32	37	40	51	60	62

Basis:
Warm air ductwork - horizontal duct at 35°C with 600 mm vertical sidewall in still air at 15 °C.
Chilled air ductwork - horizontal duct at 13°C with 600 mm vertical sidewall in still air at 25 °C
Thermal conductivity values calculated from the mean insulation temperature based on the fluid and air temperatures.
Thicknesses of mineral wool and phenolic foam are the nearest commercially available thickness to meet minimum requirements.
Thicknesses of nitrile rubber are minimum thicknesses.

2475 CONDENSATION CONTROL ON CHILLED AIR DUCTWORK :

N/A

2490 THICKNESS OF INSULATION TO BS 5422 FOR PROCESS PIPEWORK AND EQUIPMENT:

N/A

2495 THICKNESS OF INSULATION TO BS 5422 FOR REFRIGERATION PIPEWORK AND EQUIPMENT:

The chiller or refrigeration plant manufacturer or specialist refrigeration pipework installer shall select the appropriate insulation material for the application.
To control heat gain and condensation, comply with the requirements of section 6 of BS 5422 and supply minimum thickness of insulation in accordance with relevant tables below and Annexes F and H in BS 5422 to suit the system operating temperature and insulation material thermal conductivity.
Table 1 – Maximum permitted water vapour permeance in relation to plant temperature at an ambient temperature of +20°C (dry bulb).
Table 4 – Minimum insulation thickness for refrigeration applications to control condensation and control heat gain on a high emissivity outer surface (0.90) with an ambient temperature of +25°C and a relative humidity of 80%.

Table 5 – Minimum insulation thickness for refrigeration applications to control condensation and control heat gain on a low emissivity outer surface (0.05) with an ambient temperature of +25°C and a relative humidity of 80%.

3000 WORKMANSHIP

3011 GENERAL:

Install insulation in accordance with BS 5970.

Carry out thermal insulation work using a specialist firm employing skilled craftsmen conversant with class of work, being members of the Thermal Insulation Contractors Association.

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.

Where systems are to be lagged, insulate all of the items on the system (eg plenum box) unless indicated otherwise.

Separation

Insulate each unit separately. Do not enclose adjacent units together.

Clearance

Ensure 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.

All nameplates shall be covered with removable sections of insulation that are easily identifiable, or where practical, name plate is removed and repositioned on the outer face of the insulation.

The insulation shall be applied such that plant and equipment can be cleaned and inspected with allowance made for removal of access covers, bolts, nuts and probes without damage to the insulation.

Care shall be taken to ensure that where required, a complete vapour seal is maintained. In particular, the insulation to and around the points where supports, brackets and hangers occur on vapour sealed services shall ensure provision of a complete barrier to moisture transmission.

All exposed ends of insulation shall be sealed to prevent migration of fibres and then capped with suitable protective capping adequately fixed.

Where an insulated pipe/duct passes through an external building element adequate precautions shall be taken to prevent entry of the rain water into the building.

In instances where phenolic foam sections are applied to copper pipework, the pipework shall be clean and dry prior to the application of the insulation. Care shall be taken to ensure that in all cases where there is a likelihood of the copper pipework coming into contact with raw foam, a bore coating is incorporated into the phenolic foam.

Insulation shall be protected during the progress of the work and maintained dry.

NOTE:

Attention is drawn to the risk attached to the use of PIB, polyurethane, PVC, polystyrene, isocyanurates etc., even where these materials are claimed to be fire resistant and/or self-extinguishing, they have proved in the past to produce toxic smoke causing a hazard to persons working in the area and to fire fighting teams. These types of insulation or finish **shall not** be used inside of a building or areas under cover. PIB may be used external to the building only where indicated.

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 'O' 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. Ensure the passivating internal bore coating of the insulation is not damaged, particularly at corners and other irregular shapes.
Before phenolic resin foam sectional insulation is applied, ensure that all pipework is clean, dry and free of any debris or corrosive substances such as excess soldering flux, building materials.
Installation shall be by a contractor approved by the manufacturers strictly in accordance with the manufacturer's installation instructions.

3040 INSTALLATION OF INSULATION ON PIPEWORK - WITH CANVAS FINISH:
Ensure joints are close butted together and secure overlaps with adhesive and smooth out. Insulate fittings to same standard as adjacent pipework and use mitred segments where necessary. Secure with adhesive using a minimum of 50mm wide canvas to cut mitred joints. Apply two coats of class "O" polymer solution.

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 FACE SEMI-RIGID SLAB INSULATION ON DUCTWORK:
Secure the insulation with adhesive in accordance with manufacturer's recommendations. Use insulation hangers spaced at maximum 300mm centres on the underside of ducts.
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 use 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' aluminum 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 use class 'O' foil tape to continue vapour barriers.

3080 INSTALLATION OF FOIL FACED LAMELLA OR CRIMPED MAT ON DUCTWORK:
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' aluminum 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 use class 'O' foil tape to continue vapour barriers.

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.

3101 INSTALLATION OF MINERAL WOOL INSULATION ON VESSELS:

Cut Lamella or crimped mat to length to wrap around vessel 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.

On heat exchangers and HWS calorifiers in plant rooms, domed tops of calorifiers shall be finished in 0.9mm stucco embossed aluminium sheeting in coned segmental tops.

Manway chests shall be enclosed in removable stucco embossed covers lined with mineral fibre mattresses of 66 - 100 kg/M3 density, flanges and end covers on heat exchangers shall be similarly treated.

3102 INSTALLATION OF INSULATION ON FLANGED TANKS:

N/A

3105 INSULATION OF EXTERNAL DUCTWORK AND FLAT SIDED TANKS

N/A

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 in accordance with manufacturer's recommendations and arrange joints to shed water and prevent the ingress of water.

3125 INSTALLATION OF MULTI-LAYERED LAMINATE FOIL/FILM PROTECTION:

Install laminated foil/film protection, in accordance with manufacturer's instructions.

Installation may be either factory pre-applied or applied in-situ.

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.

3131 INSTALLATION OF INSULATION ON PIPEWORK - WITH SHEET METAL FINISH:

Secure insulation with metal bands at each end of section and at maximum centres of 450mm. Ensure joints are close butted together. Insulate bends with mitred segments of insulation banded into position. Insulate fittings are to the same standard as the adjacent pipework. At bends on cold services the vapour barrier surface shall be protected with a suitable absorbing strip since it will be necessary to secure any swaged segments with pop rivets, ie. the vapour barrier shall be retained by bedding any rivets into the strip (eg: Class 'O' Armaflex tape). If exposed to weather, seal all joints with suitable mastic. 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 except on pipes with vapour barrier; or metal bands.

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.

3141 INSTALLATION OF SHEET METAL FINISH ON DUCTWORK, TANK AND VESSEL INSULATION:

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.

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.

Ducting - Rectangular

The whole shall be enclosed in 0.9mm stucco embossed aluminium cladding applied in the form of lock formed strip and/or folded or flat sheeting. Care shall be taken to support as necessary the underside to minimise sagging. Cladding shall be fixed to support cladding which shall be taped to and continues the vapour barrier.

Ducting - Circular

The insulation shall be enclosed in a layer of reinforced aluminium foil, joints secured with 75mm wide soft aluminium foil self adhesive tape to maintain a vapour barrier. The whole shall be enclosed in 0.9mm stucco embossed aluminium sheeting, secured by matching aluminium straps and/or self seal rivets to avoid puncturing the vapour seal.

For low temperature ducting (below 10°C) mastic treatment shall be applied in the overlaps since rivets may puncture the vapour barrier.

3151 INSTALLATION OF PROTECTION:

Ensure that where protection is applied to insulation, the joints fall blind side and that all joints are made to shed water and sealed with waterproof tape, adhesive or joint sealant where appropriate.

3170 INSTALLATION OF PROTECTION - ALUMINIUM SHEETING:

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.

3185 APPLICATION OF WEATHER PROOF PAINTS:

Do not apply weather proof paints in ambient temperatures below 5°C

3190 INSTALLATION OF RIGID PVC PROTECTION

Apply rigid PVC sheet and pre-formed fittings directly to insulation with an overlap of at least 40mm on longitudinal and circumferential joints.

Secure longitudinal laps with plastic rivets at 150mm centres.

Ensure rigid PVC is not installed in contact with heat sources.

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.

3220 LINERS:

Where load bearing insulation is required use segmental liners suitable for temperature. Fit insulant up to liner and carry facing across the pipe ring.

3231 INSTALLATION WHERE INSULATION IS CARRIED THROUGH PIPELINE SUPPORT:

For cold services ensure insulation is carried through.

For hot services ensure insulation is carried through as scheduled.

For load bearing insulation carry through insulation and finish.

For non-load bearing insulation on hot pipework close butt to section of load bearing finished material suitable for working temperature 100mm long.

For non-load bearing insulation on cold pipework, close butt to high density phenolic foam supports. Ensure the vapour barrier is maintained.

3240 INSTALLATION WHERE INSULATION IS NOT CARRIED THROUGH PIPEWORK OR DUCTWORK SUPPORT:
Provide end caps to match applied finish.

3241 PIPE SLEEVES:
Carry finished insulation including vapour barrier through pipe sleeve.

3242 PIPE SLEEVES THROUGH FIRE RATED PARTITIONS
Where the insulation is to be carried through the partition - thermally insulated proprietary fire sleeves shall be used tested in accordance with BS 476 or BS EN `366 to meet the fire rating of the partition. The sleeves shall be either:
"Rockwool" Fire Pro Insulated fire sleeves comprising a combination of mineral wool and graphite intumescent. or
BIS "Pacifyer" one piece stainless steel sleeve with an intumescent lining the full length and 3 bands of acoustic foam adhered to the bore of the sleeve. Where the insulation is required to carry through the wall or partition / vapour seal is required oversized mineral wool shall be fitted to the pipework with an oversized Pacifyre fitted over the mineral wool.

Installation shall be in accordance with the manufacturer's requirements.

3250 INSTALLATION WHERE INSULATION IS CARRIED THROUGH DUCTWORK SUPPORT:
Provide insulation between duct and support using high-density phenolic foam or polyisocyanurate strips. Butt insulation to spacer and carry over finish by 40mm and tape joint. Provide a sheet metal protecting sleeve.

3251 DUCTWORK SUPPORTS:
On cold services, ensure insulation carried through between duct and support
Provide insulation between duct and support using high-density phenolic foam or polyisocyanurate blocks. Carry over finish by 40mm and tape joint. Provide a sheet metal protecting sleeve.
Where insulation not carried through between duct and support provide end caps or bevelled seal.

3252 DUCT SLEEVES:
Carry finished insulation through duct sleeves.

3255 VAPOUR BARRIERS
Vapour barrier shall be applied over insulation on services, plant etc, working at or below ambient temperatures and they shall be continuous, maintained dry, completed and sealed as a vapour barrier throughout before reducing the service to its working temperature.

The insulation at all support points shall be pre-formed load bearing inserts manufactured from hardwood, phenolic foam or other specified material, and to the same thickness as the adjacent insulation on each side of the brackets/support.
Each insert shall incorporate a bright aluminium foil covering to provide a vapour barrier to match that of the adjacent insulation.
The length/width of each insert shall protrude not less than 40mm on either side of the bracket/support.
The insulation either side of the brackets/support shall butt up tightly to the insert and the vapour barrier made continuous by taping the joints between the foil faces on the insulation and inserts with a minimum 50mm wide Idenden T303 Class 'O' foil tape.
For HTHW, steam and condensate pipework where roller and chairs form supports, a galvanised sheet steel protective sleeve shall be provided around the insert between the roller and the guide bracket (Phenolic foam shall not be used on HTHW and steam pipework or systems that exceed its temperature limit.
It is essential to maintain the integrity of vapour seals.

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.

3280 WATER TANKS
Arrange insulation and finish to allow removal of access covers and/or tank top.

10000 Based on NES Y50 TEXT Dec 19

Y50 – Thermal Insulation

1000 GENERAL

Undertake inspection and commissioning of the building services systems in accordance with The Building Regulations Approved Documents L1 & L2 and relevant CIBSE / BSRIA commissioning codes.

Where an existing system has been extended or modified, then, unless noted otherwise in the scope of works, the complete system shall be re-commissioned. For example if a new prime mover has been installed or the original prime mover up rated in an air or water system and the system has been extended to serve additional terminals.

Appoint a commissioning manager / Specialist Commissioning Agent and undertake Commissioning Management in accordance with CIBSE commissioning code M.

The Contractor shall review all designs to ensure that systems are commissionable in accordance with the codes of practice detailed in Y51. If additional facilities are required the Contractor shall advise the designer prior to commencing work on site.

Produce and issue a notice to the local authority at the end of the commissioning that shall declare that a commissioning plan has been produced and followed and the commissioning results confirm that the performance of the engineering systems is in accordance with the original design. Where deviations / excursions from the design have been agreed with the designers / and client these shall be documented in the notice.

During the commissioning stage systems shall not be left running / unattended without Contractor attendance on site eg overnight or during weekends. Should a component failure occur the engineering services shall be configured to safely shut down.

Where required carry out Seasonal Commissioning in accordance with clause Y51 3025 as defined in clause Y51 1002 (in accordance with the requirements of BREEAM if required) and scheduled in in A31sch1 or A31sch2 and Y51sch3.

For Dry Riser and Wet Rise firefighting mains; where identified elsewhere within this specification or required by the local fire brigade, comply with the requirements of BS 9990 Clause 7.2 for protection of buildings under construction.

BREEAM projects – requirements:

Refurbishment and Fit Out 2014 and BREEAM New Construction 2018 requirements

- Comply with Issue ID Man 04 Commissioning and Handover
- Comply with Issue ID Man 05 Aftercare
- Comply with Issue ID Ene 02 Energy Monitoring
- Comply with Issue ID Wat 02 Water Monitoring
- Comply with Issue ID Wat 03 Water Leak Detection
- Comply with Issue ID Pol 01 Impact of Refrigerants
- Refer to schedules and scope of works for project specific requirements.

1002 DEFINITIONS

The following definitions, some extracted from BSRIA Guides BG2/2010 and BG49/2013, and BREEAM New Construction 2018 and shall apply to all systems.

Capacity Tests

The proving that the capacity of installed plant and equipment items meets the specified duty.

Commissioning

The advancement of an installation from the stage of static completion to working order to specified requirements. For pipework distribution systems it includes the setting to work of an installation and the regulation of flow rates.

Design Criteria

The measurements and quantities selected as the basis for the design of a system.

Performance Criteria

The specified, numerically quantifiable, characteristics and tolerances to be achieved by the system.

Performance Testing

The proving that the installed system can maintain the specified, numerically quantifiable, characteristics and tolerances to be achieved by the system.

Fine Tuning

The adjustment of a system where usage and system proving has shown such a need.

Pre-Commissioning Checks

Specified systematic checking of a completed installation to establish its suitability for commissioning.

Pressure and Leakage Testing

The measurement and recording of pressure retention, and fluid losses or gains in the plant Equipment, distribution ways and terminals.

Regulation

The process of adjusting the rates of fluid flow in a distribution system to achieve specified values.

Setting to Work

The process of setting a static system into operation.

Static Completion

The state of the system, when it is installed in accordance with the drawings and specification, ie being clean and ready for setting to work. In the case of water systems this includes flushing, cleaning, pressure and leakage testing, filling and venting.

System Proving

Measuring, recording, evaluating and reporting on the seasonal performance of the systems against their design values.

Testing

The measurement and recording of specified quantifiable characteristics of an installation or parts thereof.
NOTE: This includes off-site testing.

Environmental testing

The measurement and recording of internal environmental conditions including temperature, humidity and noise levels (with artificial loads applied and using instruments independent of the BMS where indicated).
The measurement of external noise levels
Refer to scope of work and Y51sch2 for details.

Seasonal Commissioning or Commissioning – implementation (as defined in BREEAM 2018 NC for one credit)

For Complex systems with a specialist commissioning manager
The following seasonal commissioning responsibilities will be completed over a minimum 12 month period, once the building becomes occupied:

Complex systems with a specialist commissioning manager

- Identify changes made by the owner or operator that might have caused impaired or improved performance.
- Test all building services under full load conditions, i.e. heating equipment in mid-winter, cooling and ventilation equipment in mid-summer and under part load conditions (spring and autumn).
- Where applicable, carry out testing during periods of extreme (high or low) occupancy.
- Interview building occupants (where they are affected by the complex services) to identify problems or concerns regarding the effectiveness of the systems.
- Produce monthly reports comparing sub-metered energy performance to the predicted one.
- Identify inefficiencies and areas in need of improvement.
- Re-commission systems (following any work needed to serve revised loads), and incorporate any revisions in operating procedures into the operations and maintenance (O&M) manuals.

Where specialist building services systems such as fume cupboards, microbiological safety cabinets and a cold storage system are present then the assessor must ensure that these systems are included in the specialist commissioning agent's responsibilities

Simple systems (naturally ventilated) – with an external consultant/facilities manager.

- Review thermal comfort, ventilation, and lighting, at three, six and nine month intervals after initial occupation, either by measurement or occupant feedback.
- Identify deficiencies and areas in need of improvement.
- Re-commission systems and incorporate any relevant revisions in operating procedures into the O&M manuals.

2000 STATIC TESTING

2010z PRESSURE TESTING PIPEWORK - GENERAL:
Comply with procedures given in BESA Guide to Good Practice for Site Pressure Testing of Pipework. (TR/6) Ensure safety precautions detailed in HSE Guidance Note GS4 Safety in Pressure Testing are adopted.
Isolate components that cannot withstand the test pressures. Isolate these as near to the component as possible.
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 and ductlines before any permanent covering is applied.

Carry out works test for individual items of equipment as detailed in the work sections of this specification
Advise appropriate personnel, in advance, of the time tests may be witnessed.
Agree test pressure and duration for water mains with local water authority.

2012 PRESSURE AND LEAKAGE TESTING - AIR DUCTLINES:
Carry out air pressure and leakage testing on air ductlines in accordance with DW/143, DW/144 or DW/154 as appropriate and as indicated in section Y30.

2015 PRESSURE AND LEAKAGE TESTING - BUILDER'S WORK SHAFTS, VOIDS, ENCLOSURES AND FLOOR VOIDS / PLENUMS:
Ensure all builder's work shafts, voids and enclosures are pressure and leakage tested, and signify acceptance of standard and integrity of construction, prior to pre-commissioning of engineering installations.

Pressure test floor plenums / voids using a specialist building airtightness tester ATTMA registered to level 2 using ATTMA standard TS L2 and BSRIA BG65/2016 – Floor Plenum Air tightness Guidance and Testing Methodology.
Maximum value of plenum air leakage to be 0.7l/s/m2 of floor area at a test pressure of 50Pa or 5% of the air volume flow rate supplied to the plenum.
Maximum raise access floor leakage to be 1.0l/s/m2 of floor area without carpets at a test pressure of 50Pa

2020 PRESSURE TESTING - WATER CIRCULATING AND SUPPLY SYSTEMS AND STEAM AND CONDENSE LINES:

Carry out Hydraulic Pressure Testing as described in BESA Guide to good Practice for Site Pressure Testing of Pipework (TR/6). 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 the maximum working pressure.
Operating gauge pressure 3.5 - 7.0 bar, test gauge pressure twice the maximum working pressure.
Operating gauge pressure greater than 7.0 bar, test gauge pressure 14.0 bar or one and a half times the maximum working pressure, whichever is the greater.

Comply with BESA TR/20 part 8 for steam and condensate systems.

2030B PRESSURE TESTING - UNDERGROUND PIPEWORK:

Test to a gauge pressure twice the operating pressure or 7 bar, whichever is the greater, for 4 hours.
Test pre-insulated bonded steel pipe systems for district heating in accordance with BS EN 13941-2
Test pre-insulated non bonded pipe systems in accordance with the system manufacturer's recommendations.
Test pre-insulated bonded flexible pipe systems in accordance with the system manufacturer's recommendations

2042 PRESSURE AND LEAKAGE TESTING - WATER SERVICES INSTALLATIONS:

Inspect and test water services installations in accordance with relevant parts of BS EN 806 and BS 8558 and to the requirements of the Local Water Undertaking.
Ensure the provisions laid down in BESA TR/6 Site Pressure Testing of Pipework for testing underground CWS mains are carried out.

2050 PRESSURE TESTING - FIRE RISERS:

Undertake static pressure tests followed by flow and pressure tests in accordance with BS 9990. Demonstrate to Fire Brigade when tests are satisfactory.
On completion of the static test check operation of the non-return valves integral within the inlet breeching unit by using the static pressure exerted by the full water capacity of the riser.
For Wet Riser pipework undertake static water pressure test to a pressure not less than the system closed valve pressure exerted by the wet riser pump set when designed to operate at the flow and pressure defined in BS 9990. Ensure pressure is maintained for a minimum period of 15minutes.

2055 PRESSURE TESTING - REFRIGERANT PIPEWORK:

Comply with relevant Institute of Refrigeration (IOR) Safety Code of Practice for refrigerant used in the installation and BS EN 378-2.
Test refrigerant pipework using the strength test procedure as detailed in Clause R6.4 of the CIBSE Commissioning Code R: 2002. Test refrigerant pipework using the leak test procedure as detailed in Clause R6.5 of the CIBSE Commissioning Code R: 2002. Test refrigerant pipework using the deep vacuum test method as detailed in Clause R6.6 of the CIBSE Commissioning Code R: 2002

2062 PRESSURE AND LEAKAGE TESTING - GAS PIPEWORK OTHER THAN MEDICAL GASES:

Pressure test and commission gas infrastructure pipework (external to buildings) in accordance with BS EN 12327

Carry out a pneumatic leak test on natural gas pipework followed by a pneumatic pressure test as described in BSEA TR/6 Site pressure testing of pipework.
For Natural gas systems, Purging and soundness testing shall only be carried out by authorised persons in accordance with the Institutions of Gas Engineers Publication IGE/UP/1 "Soundness Testing and Purging of Industrial and Commercial Gas Installations".

Test records shall be kept based on IGE/UP/1 requirements and prepared to provide a record of satisfactory witnessed tests and procedures for soundness testing and purging.

For small low pressure natural gas systems comply with IGE/UP/1A and for domestic natural gas systems comply with IEG/UP1B

For other systems (such as gaseous fire protection systems), carry out a pneumatic leak test followed by a pneumatic pressure test as described in BESA Guide to Good Practice for Site Pressure Testing of Pipework (TR/6). Upon their completion, pressure/leak test the areas to be protected to ensure that their leakage characteristics are as assumed in the specialist's design.

2065 PRESSURE TESTING - OIL PIPEWORK:
Test oil pipework installation in accordance with relevant part of BS 5410 to suit the application and TR/6 Site pressure testing of pipework. BESA. Guide to good practice.

2072 PRESSURE AND LEAKAGE TESTING - PIPED MEDICAL SERVICES:
Test to requirements of Hospital Technical Memorandum 02-01 Part A.

2075 TESTING CONDENSE AND OVERFLOW SYSTEMS:
Test condensate drainage systems from cooling coils and any overflow pipework / drainage pipework from plant in accordance with BS EN 12056-2 and BESA TR/6 Site pressure testing of pipework.

2082 PRESSURE AND LEAKAGE TESTING - SOIL, WASTE, VENTILATION, ANTI-SIPHON 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.
Siphonic rainwater pipework shall be flow and positive pressure tested in accordance with manufacturer's recommendations and BS 8490.

2090 PRESSURE TESTING - UNDERSLAB DRAINAGE:
Test section by section as the work proceeds and subsequently after completion of backfilling and compaction to the satisfaction of the Engineers and the local Authority.
Individually test sections which will be permanently embedded in the structure or concealed in ducts or voids.
Submit sections to two separate tests Water test and Test for Straightness and Obstruction in accordance with BS EN 752 and BS EN 1610.

2100 VACUUM SYSTEM TESTING:
Test medical and laboratory vacuum systems in accordance with HTM 02-01 Part A and the vacuum system manufacturer and / or specialist's recommendations.

2102 TESTING WIRING INSTALLATIONS:
Ensure all electrical installations associated with the system, are tested in accordance with BS 7670 IET Wiring Regulations before any plant is run.

2112 TESTING RECORDS:
Keep a systematic record of tests. Submit samples of test record sheets for agreement prior to testing. Obtain signatures of nominated witnesses to tests. Distribute records as indicated in specification section A33.

3000 COMMISSIONING

3002 COMMISSIONING PROPOSALS

Submit proposals for commissioning as indicated in specification work Section A33 or A64 - General Engineering Technical Items. Use commissioning specialists who are members of The Commissioning Specialist Association (CSA).

3012 CLEANING DUCTWORK SYSTEMS:

Clean ductwork before plant is first run, using access openings in ductwork. Carry out cleanliness checks and procedures listed in CIBSE Commissioning Code Series A Air Distribution and BSRIA Guide BG49/2013 Commissioning Air Systems. Also refer to specification section Y30, clause 4091 and schedule Y30sch1 regarding ductwork internal cleanliness.

3014 CLEANING PIPEWORK SYSTEMS:

Flush and clean all pipework systems before the plant is first run. Carry out flushing procedures listed in CIBSE Commissioning Code W: Water Distribution Systems and BSRIA Guide BG29/2012 Pre-commissioning cleaning of pipework systems and the requirements of specification section Y25.

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.

3025 SEASONAL COMMISSIONING (or Commissioning –implementation)

Provide appropriately qualified personnel and all necessary equipment and materials to execute the seasonal commissioning works. The same organisation / team that carried out the original construction works shall undertake the seasonal commissioning.

A schedule of suitable working periods and essential services to be maintained during any work will be provided by the building operator.

A programme for the works shall be provided at least 1 month prior to the start date. This should account for any phased handovers, cause as little disruption as possible and ensure essential services are maintained.

The works shall comply with all statutory and client specific Health and Safety requirements.

Any performance deficiencies found during seasonal commissioning shall be corrected.

All seasonal commissioning shall be carried out in accordance with the project commissioning specification, an approved method statement, manufacturers' guidelines and the day-to day operational requirements of the building users.

Record all seasonal commissioning works and after completion of the works update all building documentation including O&M manuals, Building Manual, Building Log book, Building User Guide and the Building Information Model (BIM). Any changes made to the systems during the works shall be clearly identified.

BREEAM New Construction 2018 requirements

Comply with Issue ID Man 04 Commissioning and Handover.

Comply with Issue ID Man 05 Aftercare.

BREEAM Refurbishment and Fit Out 2014 requirements

Comply with Issue ID Man 04 Commissioning and Handover.

Comply with Issue ID Man 05 Aftercare

3031 COMMISSIONING WATER DISTRIBUTION SYSTEMS:

Preliminary checks

Carry out checks and procedures as detailed in CIBSE Commissioning Code W.

Ensure system is statically complete as defined in BSRIA Guide BG2/2010 Commissioning of water systems in buildings

Use pre-commissioning checklist from BSRIA guide BG2/2010

Setting to work and regulation

Set to work and regulate water distribution systems in accordance with CIBSE Commissioning Code W and BSRIA Guide BG2/2010 Undertake an initial scan of the

system and document the results. Follow guidance for commissioning of variable flow water systems in CIBSE KS9 (Commissioning variable flow pipework systems)and BSRIA BG2.

Measurement

Use instruments for measurement generally as detailed in BSRIA Guide BG2/2010

For each belt driven pump provide a change of belts and drives (to be sized after balancing the system). Allow for changing belts and drives and recommissioning pump and then rechecking system as necessary to achieve the specified duty.

For each direct driven pump (both single pumps and twin headed pumps) without inverter or other speed control, allow for a change of impeller (to be sized after balancing the system). Allow for changing impeller and recommissioning pump and then rechecking system as necessary to achieve the specified duty.

Commission district heating pipe systems using thermally insulated bonded single and twin pipe systems in accordance with BS EN 13941-2 Annex E.

Commission district heating / cooling systems in accordance with the manufacturer's recommendation.

3041 COMMISSIONING AIR DISTRIBUTION SYSTEMS:

Preliminary checks

Carry out checks and procedures as detailed in CIBSE Commissioning Code A, Section A1. Ensure system is statically complete as defined in BSRIA Guide BG49/2015 Commissioning of air systems.

Use pre-commissioning checklist in BSRIA guide BG 49/2015

Verify the fitness for purpose of installed systems before, during and after hand over in accordance with BS EN 12599 as required.

Setting to work and regulation

Set to work and regulate air distribution systems in accordance with CIBSE Commissioning Code A and BSRIA guide BG 49. Undertake an initial scan of the system and document the results.

Measurement of air flow

Use instruments for measurement and methods of measurement detailed in BSRIA Guide BG 49/2015 and CIBSE commissioning code A.

Undertake tests and checks to ventilation and air conditioning systems generally in accordance with BS EN 12599 in order to verify the fitness for purpose of the installed systems before, during and after handover. Method statement to include relevant checklists from BS EN 12599.

Where scheduled, undertake measurements in the occupied zone in air-conditioned / ventilated rooms, including the following: airflow, air velocities, temperatures and sound pressure levels in accordance with BS EN 15726.

For each belt driven fan provide a change of belts and drives (to be sized after balancing the system). Allow for changing belts and drives and recommissioning fan and rechecking system as necessary.
For each direct drive, adjustable pitch, axial fan, allow for a change of pitch angle (to be determined after balancing the system). Allow for recommissioning each system after the fan blade pitch change.

Undertake works and checks generally in accordance with BS EN 12599: *Ventilation for buildings - Test procedures and measurement methods to hand over air conditioning and ventilation systems* - in order to verify the fitness for purpose of the installed systems before, during and after handing over. Method statement to include relevant checklists from BS EN 12599.

3051 COMMISSIONING BOILER PLANT:

Follow the procedures laid down for carrying out Preliminary Checks and Start Operation in accordance with CIBSE Commissioning Code B and manufacturer's instructions.

Apparatus and Instruments

Use Apparatus and Instruments detailed in CIBSE Commissioning Code B, Appendix BA1 Apply tolerances defined in Appendix BA1.

Commission the combustion aspects steam boiler plant in accordance with the principles outlined in CIBSE Commissioning Code B. Follow the procedures in the relevant parts of BS EN 12952 and BS EN 12953 for testing, commissioning and acceptance tests of steam boiler plant. The boiler manufacturers in accordance with a method statement, which has been approved by the client's insurance inspectors and the CA, must commission steam boiler plant.

3052 COMMISSIONING STEAM SYSTEMS:

Commission steam systems in accordance with:

The boiler manufacturer, specialist steam equipment manufacturers' and water treatment specialist's recommendations

The CSA (Commissioning Specialists Association) Technical Memorandum - TM7

Steam boiler plant

Combustion aspects of steam boiler plant to be commissioned in accordance with the principles outlined in CIBSE Commissioning Code B.

Follow the procedures in the relevant parts of BS EN 12952 and BS EN 12953 for testing, commissioning and acceptance tests of steam boilers and ancillary plant.

The boiler manufacturers must commission steam boiler plant in accordance with a method statement, which has been approved by the client's insurance inspectors and the Contract Administrator.

3055 COMMISSIONING OF GAS PLANT AND SYSTEMS:

Commission gas fired plant on industrial and commercial premises in accordance with IGEM/UP/4.

Commission gas infrastructure (external to buildings) supply systems in accordance with BS EN 12327.

Undertake all completion and commissioning procedures detailed in Section 17 of IGEM/UP/2 edition 3 and provide new gas pipework commissioning checklist based on Appendix 16 in UP/2.

Provide a scheme for inspection, testing and maintenance of the gas installation for inclusion in the O&M manuals to ensure continued integrity.

3061 COMMISSIONING REFRIGERATING SYSTEMS:

Comply with relevant Institute of Refrigeration (IOR) Safety Code of Practice for refrigerant used in the installation and BS EN 378-2.

Commission refrigerating systems in accordance with CIBSE Commissioning code R.

3081 COMMISSIONING PLANT ITEMS AND OTHER SYSTEMS:

Where no CIBSE or BSRIA manuals are published that cover the commissioning of specific plant items or other systems submit detailed proposals and comply with the manufacturers' recommendations for setting to work.

3091 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.

3101 AIR SYSTEMS COMMISSIONING RECORDS TO BSRIA GUIDE BG 49/2015:

Keep a systematic record of commissioning results and distribute as indicated.

For air systems.

A record of the initial scan of the system shall form part of the commissioning results. These results shall be included in the Operation and Maintenance manuals.

Use record sheets as detailed in BSRIA Guide BG 49/2015 Commissioning Air systems.

3102 WATER SYSTEMS COMMISSIONING RECORDS TO BSRIA GUIDE BG2/2010:

Keep a systematic record of commissioning results and distribute as indicated.

For water systems

A record of the initial scan of the system shall form part of the commissioning results. These results shall be included in the Operation and Maintenance manuals.

Use record sheets as detailed in BSRIA Guide BG2/2010, Commissioning of water systems.

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 (e.g. 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.

3112 COMMISSIONING OF ELECTRICAL INSTALLATIONS:

Refer to specification section Y81

Ensure all electrical installations associated with the system are tested and commissioned before any plant is run.

Carry out electrical checks listed in CIBSE Commissioning documents:-

Series A Air Distribution Systems - A1.5

Code W: Water Distribution Systems

3120 BMS COMMISSIONING – PRE-COMMISSIONING (inc NES clause 3140)

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.

Ensure that as much pre-commissioning work as possible is performed off-site:
Ensure that the following is followed:

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 requirements of CIBSE Code C (Commissioning of automatic control systems).
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.

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

Ensure 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 of water systems BG2/2010, BSRIA
The commissioning of air systems in buildings, BG49/2015, BSRIA.

3151 COMMISSIONING BMS / 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.
Ensure that the BMS is commissioned in accordance with the requirements of CIBSE Code C
Wherever possible load, prove and commission all software off-site.
Carry out all tests necessary to ensure the correct operational state of the installation. Load and prove all software. Set all variable parameters and switches to the appropriate values and settings to ensure compliance with the specification.
Prior to activating any BMS control of plant demonstrate all safety interlocks and ensure all fail safe conditions are implemented and operational.
Record values and settings of all variable parameters and switches set as part of the commissioning process. Include these records in Record Documents.
Indelibly mark all physical adjustments to BMS devices.

3152 BMS WITNESSING REQUIREMENTS: (NES clause A32 151.000 / W60 360.010))

The Contractor shall implement the following CA's witnessing requirements. Ensure that on-site commissioning staff facilitate the witnessing process.

Confirm that the BMS hardware is installed in accordance with Section W60.
Verify any operator software and associated graphics.
Witness completely the control of any main and/or critical items of plant along with a random sample of other points.
If less than 300 points, witness all points. Between 300 and 1,000 points witness 50% (minimum of 300 to be witnessed). If more than 1,000 points witness 20% (with a minimum of 500 points witnessed).
Reserve the right to witness 100% of the points if the failure rate is greater than 5%.
Witness a sample of specific functions, eg 10% of alarms and 10% of data logging.
Witness one of several identical items of plant in detail with the others witnessed on a random basis.
Verify the system security access.
Verify that all safety-related functions perform to that specified, eg plant shutdown on fire condition.
Verify all plant restarts according to that specified after building power failure and local power failure.
Witness all power meter data-points to ensure that they match the meters.
Ensure that trend logs are used when witnessing points in order to monitor the performance of control actions.
Verify the handover of all operating manuals and system documentation.
Verify the handover of backup copies of software.
Verify the completion of any specified system operator training.

3153 BMS - POST HANDOVER CHECKS: (Edited from NES clause A32 152.000 / W60 360.050)

Ensure that the following post-handover checks are performed:
Global level checks
- Internal air temperature.
- Relative humidity.
- Ventilation levels
- Energy consumption (ensure that the pulse-input counters match the meters).
- Requirements associated with seasonal commissioning
- Soft landings requirements

Check that each of the above meets the specified requirements.

System level checks

Control strategies. Check that any suspect control strategies are appropriate for the intended application. Check that the suspect control strategy has been implemented and commissioned correctly. Check that the control strategy is still appropriate for the intended use.

Network communications. Check that all relevant field controllers communicate properly. Check for correct sharing between controllers of relevant data and correct inter-controller operation.

Control set-points. Check that the set-points in question are correct and appropriate for the actual operating conditions.

Control loop settings. Check that the control loop settings result in accurate and stable control. Check that all self-learnt characteristics are valid.

Occupant controls. Check that occupant controls work correctly.

Sub-system/component level

Sensors. Check the accuracy and location of any suspect sensors.

Actuators. Check that any suspect actuators operate correctly.

Dampers and valves. Check that there are no dampers and valves that are jammed and that they operate as intended

4000 PERFORMANCE TESTING (NES 251.050)

4010 SYSTEM PERFORMANCE TESTING / DEMONSTRATIONS:

Demonstrate the performance and control sequence, including the operation of all safety devices, of installations including single, standby, multi-duty plants and systems, and of plants specified for future use.

4015z TESTING OF RESIDENTIAL VENTILATION SYSTEMS:

Demonstrate the performance of residential ventilation systems through performance testing and installation checks in accordance with BS EN 14134.

Comply with the best practice requirements of BSRIA BG 46/2015 “Domestic Ventilation Systems – A Guide to Measuring Air Flow Rates””. For measurement of air flow rates use the unconditional method.

4020z PERFORMANCE TESTS, CAPACITY TESTS AND ENVIRONMENTAL TESTING:

Carry out performance and capacity tests and environmental testing for all systems and in all areas of the building to prove and demonstrate the performance of the systems and plant item duties.

Where applicable, on ventilation facilities correct the measured air flow rate when ambient measuring conditions are different from standard conditions in accordance with PD CEN/TS 17153.

Specific Fan Power Validation tests

After fitting clean filters, air handling systems to be commissioned under validation load. Measure the specific fan power SFP of each system for calculation of the building "as constructed" CO_2 emission rate.

Site performance testing of heating and cooling coils

Where specified in the scope of works or scheduled undertake in accordance with Commissioning Specialists Association guide TM10 – Site performance testing of heating and cooling coils.

For environmental testing, the minimum requirement is to test each room using the BMS (unless stated otherwise in Y51sch2) for at least 48hours during which period the temperature and Humidity (if controlled) set points must be varied at least twice to prove the correct responses of control systems and plant. Temperature / humidity logs shall be provided as a record of the testing.

Apply artificial loads to simulate sensible and latent gains. Use calibrated data loggers or chart recorders (independent of the BMS) in those areas detailed in the scope of works, or where indicated in schedule Y51sch2 or otherwise provide test arrangements to simulate the full range of operating conditions and duties.

Undertake system proving during the defects period by recording, evaluating and reporting on the seasonal performance of the systems against their design values. Ensure that both summer and winter maximum and minimum conditions are covered by the test results.
Carry out ambient air quality tests in accordance with BS EN 13528-1, BS EN 13528-2 and BS EN 13582-3 as scheduled.

Undertake measurements in the occupied zone in air-conditioned / ventilated rooms, including the following: airflow, air velocities, temperatures and sound pressure levels as scheduled or described in the scope of works / commissioning specification in accordance with BS EN 15726.

Carry out measurements of sound or noise levels in all internal and external areas of the building or project to demonstrate that the designed values are being achieved or not exceeded as appropriate.

4024 CONTROLS DEMONSTRATION AND VERIFICATION:

Demonstration and verification that the controls systems are fully operational, commissioned and deliverables have been made shall include, but not be limited to, the following:-

: Demonstration of operation of software prior to installation
: Audit of cabling and hardware installation
: Demonstration of physical and logical integrity of system, including demonstrating that sensors and actuators correctly connected and addressed.
: Demonstration of control actions, including operation of all safety devices
: Demonstration of sensor calibration
: Demonstration of successful system software commissioning, including reloading software and documented commissioning data from media and subsequent satisfactory operation.
: Verification of specified graphics
: Verification of satisfactory training of client's staff
: Verification of the handover of all specified operating manuals, documentation and drawings
: Verification of handover of back-up copies of software
: Verification of handover of consumable spares

4030z RECORDERS:

During performance, capacity and environmental testing provide recorders as necessary to demonstrate the system performance.

Following completion provide and maintain on free loan portable at least three seven day space temperature and relative humidity recorders, together with adequate charts.
Provide other recorders as agreed with the engineer.

4040 OTHER SYSTEMS

4040A RAINWATER SYSTEMS:

Demonstrate by flow tests that the systems give satisfactory performance.

4040B SANITARY SYSTEMS:

Comply with performance tests given in BS EN 12056 – 2.

4040C HOT AND COLD WATER / BOOSTED COLD WATER SYSTEMS:

Demonstrate and record that outlets supply adequate rates of flow.
Demonstrate that the hot water temperature at each outlet to reaches 50°C (55°C in healthcare premises) within one minute of turning on the tap.
In installations where the HWS return is local to the outlet, demonstrate that the hot water temperature at each outlet to reaches 50°C in less than 30seconds

4040D FIRE FIGHTING / SMOKE & HEAT CONTROL SYSTEMS:

Comply with requirements of the local Fire Authority, with the appropriate sections of BS 9999 and BS 9990 and the appropriate systems standards detailed elsewhere in this specification.

Comply with BS 5306-1 for hose reels.

Dry Riser System; undertake flow and pressure test at the highest outlet .of a flow of 25l/s at a running pressure of 4 bar or as agreed with the fire brigade. On each valve outlet below highest outlet undertake full bore flow test to prove no impedance to valve outlet flow

Wet Riser System; Undertake flow and pressure test at each outlet of 25l/s at a running pressure of 8bar. Or as agreed with the fire authority.
Where requested by the engineer carry out proving test of the riser's intermediate isolation valves and pump suction and delivery valves. Where the valves are monitored undertake proving test of the monitoring system by means of closing each valve and witnessing the alarm signal at the central panel location.

Wet riser storage tank infill main where installed undertake flow test utilising inline flow meter.
Carryout proving test on the open and close operation of the storage tank infill float valves and prove operation of the storage tank high water level and low water level tank alarms and witness alarm signal at the alarm panel

On each pump undertake flow and pressure proving test utilising pump back to tank test line

Undertake pump automatic start test by lowering system pressure to below pump start pressure
Test to be undertaken to each pump simulating standby pump operation by isolating lead pump and lowering system pressure..
Witness alarm signal of pump starting at alarm panel.

Simulate pump failure to prove pump failed signal on system alarm
On diesel pump set undertake '6 crank test' to simulate diesel pump failed to start signal.

4040E HYDRAULIC SYSTEMS:
Comply with requirements as indicated.

4040F MEDICAL GAS AND AIR SYSTEMS:
Comply with Health Technical Memorandum 02-01 Part A.

4040G LABORATORY AND INDUSTRIAL SYSTEMS:
Comply with requirements as indicated.

4040H GAS SYSTEMS:
Comply with the requirements of the local Authority.

4040I SILENCERS AND PLANT ACOUSTIC TREATMENT:
Demonstrate by measured tests that noise criteria indicated have been achieved.
Sound pressure levels from equipment to be measured in accordance with BS EN ISO 16032.

4040J ACOUSTIC ENCLOSURES:
Demonstrate that measured air leakage complies with scheduled values.

4050z PERFORMANCE TEST RECORDS:
Keep a systematic record of tests. Distribute records as indicated in Section A33.

4062 FINE TUNING:
Carry out fine-tuning as required by the engineer.

10000 NES
Based on NES version Y51 – Dec 19

Y52 – Vibration Isolation Mountings

1010 DESIGN INTENT:

Supply equipment indicated to ensure that vibration from equipment is not transmitted to building, other supporting structure, pipework or ductwork. Consider the potential for structure-borne noise transmission as well as vibration.

1012 SELECTION OF MOUNTINGS

Mountings and inertia bases should be selected to suit the equipment and static deflections scheduled. Number of mounts to be selected by the specialist supplier.

1013 INERTIA BASES

Inertia bases and steel frames are intended to provide a more stable base for plant, provide more uniform weight distribution, reduce the centre of gravity and, if massive enough, reduce the amplitude of vibration.

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.

1030 SPRING HANGERS:

Provide spring hangers that allow the lower hanger rod to move laterally at least 15°.

1040 LOCKING FACILITY:

Where indicated, provide lockable levelling device.

2000 PRODUCTS/MATERIALS

2011 MAT AND PAD MOUNTINGS:

Provide configured mat mountings with a waffle or ribbed section manufactured from synthetic rubber or neoprene.

or Provide pad mountings manufactured from composite synthetic rubber.

or as otherwise indicated.

Where mats are stacked, bond 1mm steel sheet thickness between each pad and to the top and base without filling voids.

2021 TURRET COMPRESSION MOUNTINGS:

Provide turret compression mountings fabricated from synthetic rubber or neoprene and mild steel.

or as otherwise indicated.

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.

2041 CAPTIVE SPRING MOUNTINGS:

Provide captive spring mountings comprising high strength low stress helical spring designed to achieve horizontal and vertical snubbing. Mount spring on resilient base pad predrilled for bolting down and protect against corrosion. Supply complete with a lockable levelling device.

2051 TURRET COMPRESSION HANGERS:

Provide turret compression hangers fabricated from synthetic rubber or neoprene and mild steel.

or as otherwise indicated.

Protect the metal from corrosion by painting and fix friction pads to top and bottom.

Provide bolt holes to allow fixing.
Construct hanger box from steel (minimum thickness 1.6mm) complete with hole for suspension rod and enlarged lower hole for drop rod to equipment.

2061 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.

Provide spring hangers that allow the lower hanger rod to move laterally at least 15°.

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.

2091 INERTIA BASES - CONCRETE FILLED:

Provide purpose built inertia bases constructed using welded steel frame formwork containing concrete reinforced with 12mm minimum diameter bars at 100mm maximum centres, 35mm above the bottom of the base; and mounted on spring compression mountings.

2092 INERTIA BASES - STEEL FRAMED:

Provide purpose built inertia bases constructed using welded steel frame mounted on spring compression mountings.

2095 MULTIPLE PUMP BASES

Where multiple pumps are fixed to a common base, and they are not to always run at the same time, provide vibration isolation to individual pumps, designed to both avoid the transmission of vibration into the adjacent pumps (in order to avoid "Brinelling" their bearings) and into the pipework to which they are connected.

2101 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.

2111 PIPEWORK NOISE ISOLATION:

Incorporate within pipework support ring purpose made isolators manufactured from synthetic rubber or neoprene.
Or provide spring hangers as indicated.

2121 PIPE WALL AND RISER SEALS:

Provide pipe sleeves, minimum length 300mm, with lining of minimum 25mm dense mineral fibre packing sealed with soft setting mastic to both sides unless otherwise indicated.

3000 WORKMANSHIP

3010 GENERAL:

Install vibration isolation equipment and carry out levelling of equipment in accordance with manufacturer's instructions.

3021 CAST IN SITU BASES:

Ensure bases are cast so that in conjunction with the plant load the design static deflection is achieved.

Y52 – Vibration Isolation Mountings

3030 FIXING:
Fix down vibration isolation mountings only where indicated.

3040 HORIZONTALLY RESTRAINED SPRING MOUNTINGS:
Ensure snubbers for limiting excessive movement are installed out of contact during normal operation.

10000 Based on version NES Y52 Dec 19

Y54 – Identification (Mechanical)

1010 REQUIREMENTS:
Identify all pipework, ductwork, equipment, appliances and ancillaries comprising the various systems.

1021 NEW SYSTEMS:
Comprehensively label and colour code throughout the works.
Any systems which have the same colour coding but serve different purposes (eg laboratory / Domestic hot and cold water services) shall have additional descriptive identification.

1030 EXISTING SYSTEMS:
Where identification details are incompatible with those required for new systems, obtain approval to mode of cross referencing.

1041 COLOURS:
To colour ranges given in BS 381C and BS 4800.

1045 PERFORMANCE and DURABILITY:
Ensure durability of all safety signage / identification is in accordance with BS ISO 17398

2000 PRODUCTS/MATERIALS

2011 PIPEWORK IDENTIFICATION:
Standards
Colour code and label to BS 1710.
Identification
Apply primary and secondary identification, 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.
Primary Identification
Apply colour bands, 300mm wide.
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.

2021 DUCTWORK IDENTIFICATION:
Standards
Generally colour code and label to BESA Specification DW/144.
Identification
Apply primary and secondary identification, 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.
Primary Identification
Apply colour bands, 300mm wide
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.

2030z 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 firefighting equipment red.

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. General labels to be white with black lettering.

Legends

Engrave plates with an approved text. Incorporate operating duty of equipment where this is not incorporated in other labelling.

2035 GRAPHICAL SYMBOLS FOR USE ON EQUIPMENT IN ACCORDANCE WITH BS EN 80416:

Graphical symbols for use on equipment to be created and applied in accordance with BS EN 80416-1, BS EN 80416-2, BS EN 80416-3.

2040z VALVES COCKS AND OTHER PIPELINE ANCILLARIES IDENTIFICATION:

Standards

Identify each valve, cock, stop valve, air vent, drain cock etc. with disk engraved with numerical reference and service. Except where exposed in occupied areas.

Discs

Securely attach metal or laminated plastic discs, minimum diameter 35mm, to each item. Discs to be white with black lettering.

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.

2050z MEDICAL GAS TERMINAL UNITS:

Label and colour code to HTM 02-01, Part A.

Label and colour code small medical gas cylinders to BS EN ISO 407.

2060z LABORATORY OUTLETS:

Colour code and label pipelines and services to BS 1710.

Colour code and label taps and valves for use in laboratories to BS EN 13792.

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 disks.

Discs

Securely attach metal or laminated plastic discs, minimum diameter 35mm, to each item.

Legends

Engrave disks 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.

2091 DANGER AND WARNING NOTICES:

Hazardous Systems

Colour code and label hazardous systems and equipment to requirements of Health and Safety Executive Guidance Notes.

On natural gas systems, provide identification and warning notices and labels (including a notice adjacent to each main and emergency shut off valve) to meet the requirements of the Gas Safety (Installation and use) Regulations 1998 as amended / ACOP L56 (2018), and Institution of Gas Engineers and Managers (IGEM) requirements.

2105 SYSTEM IDENTIFICATION INSTALLATION CHARTS:

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 for incorporation in O&M manuals 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 plant room or equipment room.

Finish

Plastic encapsulated chart.

10000 Based on NES Y54 text Dec 19

EXTERNAL CONDITIONS / OUTDOOR AIR CATEGORY	
Summer design temperatures: (used for cooling load calculations) CIBSE Guide A – Meru, Kenya.	24.9°Cdb 25.4 °Cwb
Summer design temperatures: (to be used for heat rejection plant selection)	35 °Cdb
Winter design temperatures: (used for space heating load calculations) No specific heating provided)	N/A °Cdb N/A °Cwb
Winter design temperatures: (to be used for selection of frost or preheat coils) No specific heating provided)	N/A °Cdb NA/ °Cwb
Outdoor air classification category to BS EN 16798-3	Particle pollutants ODA (P) - 1 Gaseous pollutants ODA (G) – 1 See below for required supply air class or category (SUP)

INTERNAL ENVIRONMENTAL DESIGN / COMFORT CONDITIONS

Room / Space

Rooms with comfort cooling

Summer23 °C +/- 2 °C

Summer RH% not controlled (NC).

Winter NC °C +/- NC °C
Winter NC %RH +/- NC %RH

Noise levels:

Clinical areas	NR 35
Conference room and boardrooms	NR 35
Cellular Offices	NR 35
Meeting Rooms	NR 35
Toilets	NR 40

Plantrooms not to exceed 80 dbA

VENTILATION

Ventilation design criteria:
Room / Space.

Fresh air rate for occupants 10 l/s person

Supply air class or category to BS EN 16798-3
Based on outdoor air classification category (ODA) above:
SUP – 1

Filtration standard
Classification to BS EN ISO 16890-1
ISO coarse – 65X%
ISO ePM10 – 50%

OPERATING CONDITIONS

Design operating conditions of mechanical distribution systems:

DWS operating temperature	65 °C (max)
DWS operating pressure	3.0 bar (max)
BCWS operating pressure	3.0 bar (max)
ductwork system pressure	*low*

Piped water systems pressure ratings	DWS operating pressure	PN 6
	BCWS operating pressure	PN 6

CONTRACTOR DESIGN ELEMENTS	
The following items require the Contractor to employ specialist sub-contractors complete these designs elements	DX refrigerant system - pipe sizing by specialist Sub-Contractor. Acoustic attenuators - selection by specialist sub-contractor to achieve the design NR based on actual equipment proposed by the Contractor. BEMS/MCP panel - by specialist systems house Sub-Contractor. Material Proposal Sheets (MPS) – required for all equipment in addition to the contractor design elements for design team review.

SELECTION OF FILTERS TO BS EN ISO 16890 (OR BS EN 779) – to comply with BS EN 16798-3
To meet the requirements of the indoor air in the building taking into consideration the category of outdoor air

Reference standards:

BS EN 16798-3:2017 - Energy performance of buildings. Ventilation for buildings. For non-residential buildings. Performance requirements for ventilation and room-conditioning systems (Modules M5-1, M5-4)
This standard gives classifications for outdoor air (ODA) and supply air (SUP) and gives the required filer efficiency needed to go from an ODA level to a desired SUP level.

PD CEN/TR 16798-4:2017
Energy performance of buildings. Ventilation for buildings. Interpretation of the requirements in EN 16798-3. For non-residential buildings. Performance requirements for ventilation and room-conditioning systems (Modules M5-1, M5-4)

Ref BS EN 16798-3 Annex B.4.3

Outdoor air classification

ODA 1 - Outdoor air, which may be only temporarily dusty (eg pollen)
Applies where the world health organisation WHO (2005) guidelines or any National air quality standards or regulations are fulfilled (annual mean for particulate matter pm2.5 ≤ 10 µg/m^3 and pm10 ≤ 20 µg/m^3).

ODA 2 - Outdoor air with high concentrations of particulate matter and /or gaseous pollutants
Applies where pollutant concentrations exceed the WHO guidelines or any National air quality standards or regulations are fulfilled by a factor of up to 1.5. (ie for pm - annual mean for pm2,5 > 15 µg/m3 and pm10 > 30 µg/m3).

ODA 3 - Outdoor air with very high concentrations gaseous pollutants and / or particulate matter
Applies where pollutant concentrations exceed the WHO guidelines or any National air quality standards or regulations are fulfilled by a factor of greater than 1.5

Table 6 below is taken from PD CEN/TR 16798-4 (which supports BS EN 16798-3)
Follow the steps in section 9.2.2.1 of this standard (provides a decision tree) to classify the outdoor air quality – both for gaseous ODG (G) and particle ODA (P) pollutants.

Table 6 — Key air pollutants, example

Pollutant	averaging time	guideline value 2008/50/EC	guideline value WHO 2005
Gaseous Components			
Sulfure dioxide SO_2	10 min		500µg/m3
Sulfure dioxide SO_2	1 h	350 µg/m³ max 24 d exceeding	
Sulphur dioxide SO_2	24 h	125µg/m³ max 3 days exceeding	20µg/m3
Ozone O_3	8 h		100µg/m3
Nitrogen dioxide NO_2	1 year	40µg/m³	40 µg/m³
Nitrogen dioxide NO_2	1 h	200µg/m³ max 18 days exceeding	200 µg/m³
Benzene	1 Year	5µg/m³	
Carbon monoxide CO	24 h	10 mg/m³	
Lead	1 Year	0,5µg/m³	
Particles			
Particulate Matter $PM_{2,5}$	24 h		25 µg/m³
Particulate Matter $PM_{2,5}$	1 Year		10 µg/m³
Particulate Matter PM_{10}	24 h	50 µg/m³ max. 35 days exceeding	50 µg/m³
Particulate Matter PM_{10}	1 year	40 µg/m³	20 µg/m³

NOTE 1 PM_{10} is only referred to in the Council Directive 99/30/EC revision [23], and resulted in Directive 2008/50/EC. Directive 2008/50/EC introduced other air pollutants: benzene CO Lead. No further revision is planned as an outcome of current air quality policy review.

NOTE 2 The WHO 2005 air quality guidelines for particulate matter, Ozone, Nitrogen dioxide and sulfur dioxide introduced $PM_{2,5}$.

Supply air classification

SUP 1 – supply air with very low concentration of particulate matter and / gases.
Applies where the supply air fulfils the WHO (2005) guidelines limit values and any National air quality standards limit values or regulations with a factor x0,25
(Annual mean for PM2,5 ≤ 2.5 µg/m3 and PM10 ≤ 5 µg/m3).

SUP 2 - supply air with low concentration of particulate matter and / gases.
Applies where the supply air fulfils the WHO (2005) guidelines limit values and any National air quality standards limit values or regulations with a factor x0,5
(Annual mean for PM2,5 ≤ 5 µg/m3 and PM10 ≤ 10 µg/m3).

SUP 3 -supply air with medium concentration of particulate matter and / gases.
Applies where the supply air fulfils the WHO (2005) guidelines limit values and any National air quality standards limit values or regulations with a factor x0,75
(Annual mean for PM2,5 ≤ 7.5 µg/m3 and PM10 ≤ 15 µg/m3).

SUP 4 - supply air with high concentration of particulate matter and / gases.
Applies where the supply air fulfils the WHO (2005) guidelines limit values and any National air quality standards limit values or regulations.
(Annual mean for PM2,5 ≤ 10 µg/m3 and PM10 ≤ 20 µg/m3).

SUP 5 - supply air with very high concentration of particulate matter and / gases.
Applies where the supply air fulfils the WHO (2005) guidelines limit values and any National air quality standards limit values or regulations with a factor x 1,5
(Annual mean for PM2,5 ≤ 15 µg/m^3 and PM10 ≤ 30 µg/m^3).

<u>The table below gives examples of classes of filters to BS EN 16890 (or BS EN 779) to meet minimum efficiency recommended in BS EN 16798-3</u>

Sources

Eurovent 4/23-2018 "Selection of EN ISO 16890 rated air filter classes for general ventilation applications"

BS EN 16798-3 (table B.3 & table 17 in section 9.7)

PD CEN/TR 16798-4)

Outdoor air quality	Supply air quality / filter examples

			BS EN ISO 16890 (BS EN 779)				
category	WHO guideline $PM_{2.5}$ ($\mu g/m^3$)	WHO guideline PM_{10} ($\mu g/m^3$)	**SUP 1** $PM_{2.5} \leq 2.5$ $PM_{10} \leq 5$	**SUP 2** $PM_{2.5} \leq 5$ $PM_{10} \leq 10$	**SUP 3** $PM_{2.5} \leq 7.5$ $PM_{10} \leq 15$	**SUP 4** $PM_{2.5} \leq 10$ $PM_{10} \leq 20$	**SUP 5** $PM_{2.5} \leq 15$ $PM_{10} \leq 30$
ODA 1	≤10	≤20	ePM_{10} 50%+ ePM_1 60% (M5+F7)	ePM_1 50% (F7)	$ePM_{2.5}$ 50% (F7)	ePM_{10} 50% (F7)	ePM_{10} 50%
	≤10	≤20	ePM_1 70% (M5+F7)	-	-	-	-
ODA2	≤15	≤30	$ePM_{2.5}$ 50% + ePM_1 60% (F7+F7)	ePM_{10} 50% + ePM_1 60% (M5+F7)	ePM_1 50% (F7)	$ePM_{2.5}$ 50% (F7)	ePM_{10} 50% (M5)
	≤15	≤30	ePM_1 80% (F7+F7)	ePM_1 70% (M5+F7)	$ePM_{2.5}$ 70% (F7)	ePM_{10} 80% (F7)	-
ODA3	>15	>30	$ePM_{2.5}$ 50+ + ePM_1 80% (F7+F9)	$ePM_{2.5}$ 50% + ePM_1 60% (F7+F7)	ePM_{10} 50% + ePM_1 60% (M6+F7)	ePM_1 50% (F7)	$ePM_{2.5}$ 50% (F7)
	>15	>30	ePM_1 90% (F7+F9)	ePM_1 80% (F7+F7)	$ePM_{2.5}$ 80% (M6+F7)	ePM_{10} 90% (F7)	ePM_{10} 80% (F7)

Requirements for gas-phase molecular filtration (eg activated carbon)	
Recommended	
Required	

NOTE - From BS EN 16798-3 section 9.7.1

In cases where supply air level of SUP 1 or 2 is required and where the outdoor air quality based on gaseous components is of level ODA 2 or ODA 3 it is recommended to complete the particle filtration with suitable gas phase filtration (Table 17) to reduce harmful levels of CO, NOx, SOx, VOC and O_3.
(Filters tested to BS EN ISO 10121 pts 1&2)

Equipment Selections

Any component pressure drops etc. quoted in individual Work Section selection schedules are "notional" figures used for the purpose of preliminary plant and motor selections.
Where "maximum" figures are quoted these are not to be exceeded when selecting equipment.

The Engineering Services Contractor shall substitute the actual pressure drops, flow rates etc. through all components, as purchased and as the final installation configuration, and recalculate equipment duties before selecting and ordering equipment and associated prime movers.

Control Dampers

Use opposed blade control dampers unless otherwise indicated. Select and size control dampers to provide authority as follows:

Opposed blade 5% (ie the pressure loss across a fully open OBD is approximately 5% of the loss in the rest of the system)

Parallel blade 20%

Fans

Quoted fan duties are based on pressure losses external to any air handling unit or distribution components and on the equipment airside pressure losses stated on the schedules.

Pressure loss allowance for air filters are to be based on the 'dirty' condition.

Quoted fan duties include the following commissioning allowances:-

	Low Pressure Systems	Medium & High Pressure Systems
On Flow Rates	10%	5%
On Head	20%	15%

Fans heads are based on the layout drawings and specified types of duct fittings and as appropriate system resistances stated in schedule of AHU's Y40 or schedule of fans Y41. If changes are made to the routes by the installer, fittings other than those specified are installed or the resistances of the

components selected are different from those stated, adjust fan head to compensate and advise the S.O. of the adjustment.

Pumps

Quoted pump duties include the following commissioning allowances:

Flow Rate	10%
Head	15%

Pump heads are based on the layout drawings and specified types of pipe fittings and as appropriate the system resistances stated in Y20 schedule of pumps. If changes are made to the routes by the installer, fittings other than those specified are installed or the resistances of the components selected are different from those stated, adjust pump head to compensate.

Water

Cold water Storage 90 Litres/person to provide 24hours cover for interruption of supply.
Mains Water Pressure assumed to be greater than 3.0 Barg. Connection to project handshake point by KDF.

Drainage

Soil and waste design - 95% of potable water demand.

Rainwater

An average of the March, April, May (MAM) and October, November, December (OND) rainfall values for 2020 for Meru County have been used to assess the rainwater yield for the rainwater harvesting systems, Reference: State of the climate report Kenya 2020, Table 13, An average value of 70cm has been used in the calculations.

Service	Material	Finish	Joints	Fittings	Notes
Mains Cold Water Cold Water Down Services Hot Water Services HWS Cold Feed Overflows Warning Pipes Condense drains Hosereel service LTHW final connections Chilled water final connections ASPs Waste and vent lines 54mm Equipment vent and drain lines for water services	Copper to BS EN 1057 R 250	Uncoated	Crimped; pipework and fittings to be of the same manufacturer and system. No hot works are permitted.	To match system used	Fittings for waste installations shall be waste type, swept in the direction of flow. Grease-based flux shall not be used
Refrigeration and air conditioningg	Copper to BS EN 12735-1 (BS EN 12735-2 for tubes for equipment)	uncoated	brazed	capillary	Brazing to be carried out using continuous Oxygen Free Nitrogen (OFN) purging.
Waste pipes and anti siphon pipes	Plastic PVC-U to BS EN 1329-1 / BS 4514 for for system components or requirements not covered by EN 1329-1	uncoated	socket and spigot for solvent welding	socket and spigot for solvent welding	
Soil floats and associated anti sophon pipes	Plastic PVC-U to BS EN 1329-1 / BS 4514 for for system components or requirements not covered by EN 1329-1	uncoated	socket and spigot for solvent welding	socket and spigot for solvent welding	Plastic PVC-U to BS EN 1329-1 / BS 4514 for for system components or requirements not covered by EN 1329-1
Vent pipes and anti-siphon pipes associated with discharge stacks	Plastic PVC-U to BS EN 1329-1 / BS 4514 for for system components or requirements not covered by EN 1329-1	uncoated	socket and spigot for solvent welding	socket and spigot for solvent welding	
Discharge stacks	As waste pipes				
Incoming CWS	Polyethylene to BS EN 12201-1 or WIS 4-32-19 SDR11	Uncoated self colour blue	Fusion welded	Fusion welded WIS-4-32-14	To be laid in sand layer. For contaminated landSite is classed as brownfield use WIS 4-32-19 barrier pipe

Y10sch2 – Schedule of Pre-Insulated Underground Pipework

System	
Application	Pipework from external plant to building: STHW collectors to plantrooms.
Type	Bonded flexible plastic service pipes to BS EN 15632-1 and BS EN 15632-2 – Ref Y10.2882
Configuration	Single flow and return pipes or dual F&R in single casing
Distribution mains	
Carrier pipe material	Cross linked polyethylene (PE Xa)
Insulation material	PU or PE
Outer casing material	PE
Branch connections to buildings	
Carrier pipe material	Cross linked polyethylene (PE Xa)
Insulation material	PU or PE
Outer casing material	PE
Fluid conveyed	Water
Maximum operating temperature (°C)	90
System design flow temperature (°C)	65
System design return temperature (°C)	55
Maximum working pressure (barg)	3.0
Test pressure (barg)	6.0
Insulation certified conductivity (W/mK)	
System service life expectancy	greater than 50 years when operating at 80ºC for a minimum of 12 hrs, 365 days/year".
System daily operating time (hrs)	24/7
System annual operating time (days)	365
Pipework system testing requirements	2 x WP for 24hours

Notes

1. Installation - refer to clause Y10.9060
2. Refer to drawings for further system details, including valve types / locations, pipe sizes, details of maximum and minimum flow rates and pressure drops in all section of the system.
3. Details of equipment, pipework and the distribution system layout indicated on the layout drawing(s) are approximate.
4. Provide a complete installation capable of performing within the specified design conditions for the duration of the systems design life. The system will be fully in accordance with the recommendations and instructions of the pipe component manufacturer.
5. The distribution of forces and pipe movement for the whole piping system shall be fully assessed and a complete system installed including all required expansion facilities.
6. Maximum resultant stresses and movements shall be considered at all critical positions in the proposed piping system. Critical positions shall include anchors, bends, branches and building entries.
7. All loading conditions shall be considered in order to ensure that maximum values of resultant stress and movement have been established. The effect of structural discontinuities and pipeline supports shall be taken account of.
8. The supplier /specialist installer shall liaise with all other utilities in the design and selection of routes

System / location	DW 144 Pressure Classification (+ve or –ve)	Material	Operation: Variable volume or CV	Leakage Testing Required to DW143 Yes/No	% of system to be leakage tested	Cleanliness quality class BS EN 15780	Protection, Delivery & Installation Level (Ref BESA TR/19)	Post Installation clean Yes/No	Notes, finish/ fire rating requirements / other test requirements
Internal HVAC	Low pressure Class A (+ve)	Galvanised Steel	CV	**No**	**N/A**	Low	Intermediate	No	

Notes

1. Connections between galvanised ducts and AHU/MVR units to be flanged
2. Access doors to plastic ductwork to be flanged and bolted
3. Grilles and diffusers and associated plenum boxes shall be supported independently of the ceiling grid unless indicated otherwise.
4. Refer to clauses Y30 3051 & 4091 for locations of cleaning access doors. The facilities incorporated in the ductwork fabrication / installation drawings shall be confirmed as acceptable by a specialist ductwork cleaning contractor prior to installation.
5. Refer to clause Y30 3101 for flexible ductwork.

Service	Location	Material	Applied Finish	Function (N, F or C)	Notes
HWS HWS storage vessels Calorifiers Heat exchangers and other pipeline mounted components	In plant areas	Rock or Glass Mineral wool	Hammerclad Aluminium or sheet steel coated with aluminium / zinc alloy	N	Insulation shall be carried through the pipeline supports including all off-site prefabricated pipework / modules. For temperature maintenance of HWS pipework with trace heating the insulation thickness shall be agreed with the trace heating specialist to suit the tape selected. Phenolic foam sections shall have a suitable dust suppressant, acid neutralising and passivating internal coating. All exposed edges of phenolic foam insulation shall be sealed to the surface being insulated with a suitable vapour sealing mastic
	Internally in voids and ducts		Class O Aluminium foil	N	
	Internally where visible other than plant areas (exposed).		Class O Aluminium foil	N	
	Externally		laminated foil/film protection (eg Venturclad - can either factory pre-applied or applied in-situ)	N	
CWS including heat exchangers pumps and other pipeline mounted components Condensate Drains	In plant areas	Rock or Glass Mineral wool	Hammerclad Aluminium or sheet steel coated with aluminium / zinc alloy	N / C	Vapour seal required in all locations, including supports Phenolic foam sections shall have a suitable dust suppressant, acid neutralising and passivating internal coating. All exposed edges of phenolic foam insulation shall be sealed to the surface being insulated with a suitable vapour sealing mastic
	Internally in voids and ducts		Class O Aluminium foil		
	Internally where visible other than plant areas (exposed)		Class O Aluminium foil		
	Externally		N/A		
	Internally where visible other than plant areas (exposed)		Class O Aluminium foi lon each layer of insulation		

Service	Location	Material	Applied Finish	Function (N, F or C)	Notes
Water Tanks	Internally	Pre-insulated CFC and HCFC free phenolic foam in slab form	GRP self finished	F/C	
Refrigerant pipework	All	Closed cell Nitrile rubber	Class O	N	Apply protection to all insulation which could be subject to damage.
Supply ductwork (including inlet D/W to AHU or fan) Extract ductwork downstream of reclaim coils	In plant areas	On rectangular ducts use Rock or Glass Mineral wool. On circular or flat oval use Mineral fibre lamella mat or crimped mat.	Hammerclad Aluminium or sheet steel coated with aluminium / zinc alloy	N (N/C on cooled ducts)	Insulation on supply ductwork carrying chilled air to incorporate continuous vapour seal

Service	Location	Material	Applied Finish	Function (N, F or C)	Notes

Supply ductwork (including inlet D/W to AHU or fan) and duct mounted components. Extract ductwork before a heat recovery device	Internally in voids and ducts and where visible when the duct surface temperature is below the dew point of the space served.	On rectangular ducts use Rock or Glass Mineral wool rigid insulation. On circular or flat oval use Mineral fibre lamella mat or crimped mat	In voids & ducts - Class O Aluminium foil. Visible ductwork to be clad with stainless steel sheet or RAL colour coated steel or aluminium sheet.	N (N/C on cooled ducts)	Insulation on supply ductwork carrying chilled air to incorporate continuous vapour seal. Extent of insulation to include ductwork downstream of fan coil and VAV / CV terminal units including terminal plenum boxes
	Internally where visible other than plant areas (exposed) carrying air above 20°C	N/A	N/A	N/A	N/A
	Externally	N/A	N/A	N/A	N/A
Extract ductwork	Externally before a Heat recovery device. Hot air exhaust ductwork where the ductwork could radiate heat back to the room (eg extract from UPS)	N/A	N/A	N/A	N/A

Functions:

N Normal: The control of heat loss and gain
F The prevention of freezing
C The prevention of surface condensation

Notes.

1. Refer to Workmanship Specification Section Y50 for appropriate thickness of insulation to suit specified function.
2. Refer to Y50 clauses 1021, 1031 and 1036 for: Standards; Regulations; fire classification for surface spread of flame, fire propagation, combustibility of materials, smoke emission and production of faming droplets.
3. Refer to clause Y50 2221 for valves, ancillaries and flange insulation requirements
4. In locations where insulation cannot be installed adequately after pipeline or duct line installation, pre-insulated sections shall be installed. Insulation to such sections shall be equivalent in thermal and physical properties to that specified for the remainder of the system including vapour barriers.

End of Specification

This is the final page of the specification.