



St Richards Hospital West Block new ventilation plant

Mechanical & Electrical Services Specification

for

Western Sussex Hospitals NHS Foundation Client

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Contents

PART A – Project Details	6
A1 The Project	6
A1.1 Scope of Works	6
A1.2 Extent of Works.....	7
PART B – Contract Conditions.....	8
B1 General Contract Conditions.....	8
B1.1 General.....	8
B1.2 General Conditions and Definitions	8
B1.3 Form of Contract.....	8
B1.4 Programme	9
B1.5 Welfare and Site Storage	9
B1.6 Site Visits	9
B1.7 Site Access	9
B1.8 Site Services.....	9
B1.9 Site Parking/ Deliveries	9
B1.10 Construction and Working Drawings	9
B1.11 Statutory Acts & Regulations	10
B1.12 Builders Works.....	11
B1.13 Protection and Storage	11
B1.14 Fire Stopping and Smoke Barriers	11
B1.15 Noise and Disturbance	12
B1.16 Site Waste Management Plan (SWMP)	12
B1.17 Completion of Works.....	12
B1.18 Inspection and Measurement of Work.....	14
B1.19 Security and Safety.....	15
B1.20 Approval.....	15
PART C – Description of Work.....	16
C1 The Works.....	16
C1.1 Mechanical Survey/ Validation	16
C1.2 Strip-Out Works & Protection of Live Services	16
C1.3 Plant Support.....	16
C1.4 Ventilation	17
C1.4.1 West Wing Ventilation	17
C1.4.2 East Wing Ventilation.....	18
C1.5 Chilled Water	18
C1.6 LTHW System.....	19
C1.6.1 Flushing Valve	19
C1.7 Central Control/ Building Management	20
C1.7.1 General	20

C1.7.2 Mechanical Services Control Panel MSCP01 21

C1.6.3 Mechanical Services Control Panel MSCP02 22

C1.7 Electrical Services..... 25

C1.8 Fire Stopping 27

PART D – Project Particular Materials/ Schedules 28

D1 Mechanical 28

 D1.1 Pipework Materials 28

 D1.1.1 Heating & Chilled water 28

 D1.2 Ductwork..... 28

 D1.2.1 General Ventilation..... 28

 D1.3 Thermal Insulation..... 28

 D1.4 Ventilation Plant 29

 D1.5 LTHW/Chilled Water/ 34

 D1.6 LTHW/Commissioning Sets/Motorized Valves..... 35

PART E – Workmanship and Materials 36

E1 General 37

 E1.1 General Requirements 37

 E1.2 Statutory Requirements..... 37

E2 Pipelines and Fittings 38

 E2.1 Chilled Water Pipework 38

 E2.1.1 Application 38

 E2.1.2 Pipe: ABS 38

 E2.1.3 Pipe: Fittings..... 38

 E2.2 LTHW Pipework..... 38

 E2.2.2 Pipe: Mild Steel Heavy Quality..... 38

 E2.2.3 Pipe: Fittings..... 38

 E2.3 Pipeline Supports..... 38

 Schedule of Support Spacings..... 39

 E2.4 Schedule of Pipeline Materials..... 40

 E2.5 Pipeline Supports..... 41

 E2.5. 1 Schedule of Support Spacings 42

 E2.6 Pipeline Jointing 42

 E2.7 Installation 44

 E2.8 Valves And Cocks 46

E3 Pipelines and Fittings Above Ground Drainage 50

 E.3.1 Pipework and fittings..... 50

 E.3.2 Pipework Installation 50

 E.3.3 Expansion and Contraction..... 51

 E.3.4 Sleeves..... 51

 E.3.5 Fire protection of pipework 51

E.3.6	Ducts and Access for Pipework	51
E.3.7	Testing.....	52
E.3.7.1	General	52
E4	Identification And Finishes	52
E4.1	General.....	52
E4.2	Pipework and Ductwork.....	52
E5	Ductwork And Fittings	53
E5.1	General.....	53
E5.2	Galvanised Ductwork	53
E5.3	Rectangular and Circular Ductwork.....	53
E5.4	Flexible Ductwork Connections	54
E5.5	Volume Control.....	54
E5.6	Fire/Fire/Smoke dampers	54
E5.7	Test Points and Instruments	54
E6	Water Treatment.....	55
E6.1	General.....	55
E6.2	Piped Systems.....	55
E7	Testing And Commissioning.....	57
E7.1	General.....	57
E7.2	Definitions	57
E7.3	Personnel.....	58
E7.4	Instrumentation	58
E7.5	Commissioning Sets	58
E7.6	Environmental Checks.....	58
E7.7	Procedures.....	58
E7.8	Pipework Systems and Plant	60
E7.9	Test Pressures.....	61
E8	Automatic Controls And Wiring	61
PART F	Tender Deliverables	62
F1	Tender Breakdown.....	63
F2	Day Work Rates	64
E3	Schedule of Rates	64
E4	Tenderers Signature	64
E5	Other Information.....	64

PART A – Project Details

A1 The Project

A1.1 Scope of Works

The works comprise of the installation of new ventilation plant on the roof of West Block at St Richards Hospital, Chichester.

The Contractor shall employ the Clients preferred controls specialist who shall carry out all associated controls works associated with the new air handling plant.

The Contractor shall supply employ specialist Roof-Pro, Polwell Lane, Burton Latimer, Kettering NN15 5PS to design, supply and install, new air handling unit support platforms with maintenance platforms.

The Contractor should note that the project shall be completed within a fully occupied and functional hospital campus. All/ any shutdowns that may be necessary to complete the installation, testing and commissioning of the new air handling plant shall be carried out at a convenient time to the Client and fully co-ordinated with the Client.

The Contractor shall produce a detailed programme of works for the project prior to commencement, which shall be agreed with the Client.

The Contractor shall liaise with the Client for the provision of an Asbestos Register associated with the proposed area(s) of works. Notwithstanding, all personnel working in and around the premises shall remain vigilant for the presence of possible asbestos containing material(s) throughout the works and report any material found that may appear suspicious of potentially containing asbestos immediately. The Contractor shall not disturb in any way any materials that may be considered to contain asbestos.

A1.2 Extent of Works

The extent of works contained within this Contract comprises:

- Survey and validation of existing ventilation plant in east and west roof plantrooms, including associated LTHW (low temperature hot water) and Chilled Water.
- New air handling plant roof platforms with maintenance access platforms.
- New air handling plant including craneage.
- New ventilation ductwork, LTHW and chilled water connecting between the new air handling plant and the existing services in the east and west plantrooms.
- Builderswork.
- Temporary control arrangements to keep existing plant running to facilitate installation of new mechanical services control panels.
- Strip out of redundant ventilation fans and ductwork.
- Pressure testing of air handling plant and ductwork, and clinical cleaning of ductwork.
- Testing and commissioning.
- Site surveys.
- Testing and commissioning.
- Provision of method statements.
- Demonstration of ventilation systems to Client.
- Provision of all Installation/ Working drawings, Record drawings and O&M manuals.

PART B – Contract Conditions**B1 General Contract Conditions****B1.1 General**

The Main Contractor shall:

Ascertain the nature of the site, access there to and local conditions and restrictions likely to affect the execution of the works.

The works shall generally comprise of the whole of the labour and all the materials necessary to form complete installation and such tests, adjustments and commissioning as are prescribed in subsequent clauses and as may otherwise be required to give an effective working installation to the satisfaction of the Engineer.

The words 'Complete Installation' shall mean not only the items of equipment conveyed by this specification, but all the incidental sundry components necessary for the complete execution of the works and for the proper operation of the installation, whether or not these sundry components are mentioned in detail in the Tender documents issued in connection with the contract.

The Main Contractor shall employ a Site Foreman who once appointed should not be changed without the approval of the Engineer and any operatives found inadequately capable should be replaced forthwith. The Main Contractor shall provide competent personnel and adequately experienced operatives for all stages of the works.

The Main Contractor shall be NICEIC approved.

B1.2 General Conditions and Definitions

The Client/ Employer shall be Western Sussex Hospital NHS Foundation Client.

The Building Services Engineer shall be AMA Ltd.

The Structural Engineer shall be Cowan Consultancy Ltd.

The Contractor is employed by the Client to complete the works.

B1.3 Form of Contract

Form of Contract between the Client and the Contractor shall consist of the JCT Minor Works with Contractors Design Building Contract 2016.

B1.4 Programme

TBC

The Contractor shall review the programme regularly and record progress on a chart kept on site.

B1.5 Welfare and Site Storage

The Contractor shall provide all necessary Welfare facilities for their work force within a designated site compound in a suitably agreed position with the Client.

Storage albeit negligible due to the nature of the proposed works will not be available within the main hospital building. Therefore, the Contractor shall allow for provision of a lockable storage container.

B1.6 Site Visits

The Contractor shall make arrangements to visit site through the Engineer.

B1.7 Site Access

The area of works is located on the roof of west block on the site of St Richards Hospital, Chichester, via lift/stairs to the east plantroom.

Keys can be organised through the Client once the Contractor has been appointed.

B1.8 Site Services

Electrical and water services will be available for use by the Contractor at the building/ site compound, necessary for the completion of the works at no cost to the Contractor.

B1.9 Site Parking/ Deliveries

The Contractor shall note that there is no specific site parking available and that the contractor(s) will have to make use of the Public Car Parks for parking. Parking passes/ permits can be arranged through the Client for the duration of the project.

A specific location for deliveries can be agreed with the Client for the purpose of convenience (proximity to the site compound) and for the purposes of storage. The delivery of the air handling units will require organisation through the Client due to the size of the plant and the time and effort involved in off-loading and positioning of these units.

B1.10 Construction and Working Drawings

The Contractor shall note that the drawings issued by AMA Ltd. for Tendering and Construction purposes only detail 'Design Intent'.

The following mechanical and electrical services drawings are issued for tender purposes and should be read in conjunction with this specification and the Main Contract conditions:

1451M001	Existing Mechanical Services West Wing Plantroom
1451M002	Existing Mechanical Services East Wing Plantroom
1451M100	Proposed mechanical services roof level
1451M101	Proposed mechanical services roof level West Wing Plantroom
1451M102	Proposed mechanical services roof level East Wing Plantroom

The Contractor shall develop and produce Construction drawings from site dimensions and manufacturers' certified drawings/ information. Working drawings shall detail installation details to include all necessary dimensions, setting out and detailed builders work drawings, wiring diagrams etc. for the execution of the installation.

These shall be issued to the Engineer for comment prior to commencement of the installation.

The Contractor shall be responsible for the production of coordinated drawings. Coordination shall take into account all existing services, electrical, mechanical and drainage where applicable and all existing and proposed building and architectural features.

B1.11 Statutory Acts & Regulations

The installation shall comply with all relevant statutory instruments and regulations including (but not limited to) the following:

- Statutory Obligations
- Health and Safety at Work etc. Act 1974
- Management of Health & Safety at Work Regulations 1999
- The Working Time Regulations 1998
- Building Regulations 2000 and current amendments
- Health Technical Memorandum
- Health Building Notes
- Public Health Acts
- Electricity Acts
- Electricity at Work Regulations 1989
- Clean Air Act 1993
- The Control of Pollution Act 1974 and Amendment Acts
- The Workplace (Health, Safety and Welfare) Regulations 1992
- The Construction (Design and Management) Regulations 2015 .
- The Health and Safety (Display Screen Equipment) Regulations 1992
- The Clean Air (Arrestment Plant) (Exemption) Regulations 1969
- The Control of Substances Hazardous to Health (COSHH) Regulations 2002
- The Control of Substances Hazardous to Health (Amendment) Regulations 2003
- Control of Asbestos at Work Regulations 2002
- The Provision and Use of Work Equipment Regulations 1998
- Personal Protective Equipment at Work Regulations 1992
- The Construction (General Provisions) Regulations 1961
- The Lifting Operations and Lifting Equipment Regulations 1998
- Public Utility Company and/or Statutory Authority regulations, specifications, and requirements.
- British Standards and Codes of Practice.
- BS 7671 - Requirements for Electrical Installations (IET Wiring Regulations).
- BS EN 50110.
- Insurance Company Requirements.
- LDSA Fire Safety Guides.
- IEC Standards.
- Notify all authorities in accordance with their regulations and obtain any required approvals for the installation.
- Where no specific design, performance or installation standards are quoted the following shall apply.
- CIBSE Guide Books
- Guide A Environmental design
- Guide B Heating, Ventilating, Air Conditioning and Refrigeration

- Guide C Reference data
- CIBSE Technical Memoranda.
- Ensure all equipment and systems are designed and installed in accordance with the relevant standards and that operational compatibility exists between the systems and any other system installed at the same location.

B1.12 Builders Works

The Contractor shall complete all builders works (if applicable) associated with the project.

B1.13 Protection and Storage

The Contractor shall be responsible for the 'off-loading' and handling of all equipment and supplies and shall provide protection for the works and all unfixed commodities against dirt, moisture, mechanical damage and any other hazard. Due allowance shall be made for adequate and safe storage of all materials, plant and equipment necessary for the execution of the works.

Deliveries shall be programmed to cause the least disruption possible to the operation of the Client.

The Contractor shall ensure the building and its grounds are kept clear of rubbish at all times and shall allow for the regular clearance of all redundant materials and rubbish including the loading of skips (where applicable). All areas shall be kept clear of all rubbish during the works, at the end of each working period and at the completion of the works.

B1.14 Fire Stopping and Smoke Barriers

If applicable, where cables, conduits, trunking or other ducts pass through fire or smoke stop barriers, such as compartment wall or floors, the opening shall be permanently sealed to maintain the integrity of the compartment barrier to its designated fire resistance rating defined by the Building Regulations approved document B2/3/4.

If applicable, where trunking or ducts pass through fire or smoke stop barriers, internal barriers shall be provided, equal to rock wool materials or fire resistant compound to maintain the integrity of the compartment barrier meeting IET Wiring Regulations 527-02-03.

If applicable, plastic conduit (UPVC or other) of internal dimensions greater than 38mm that passes through a fire or smoke stop barrier shall be fitted with intumescent collars fitted at the barrier and attached to the barrier. Collars shall have been tested to BS 476 Part 20:1987 and installed to comply with BS Code of Practice 413.

B1.15 Noise and Disturbance

The Contractor shall:

- Notify the Client prior to connecting in/ or isolating of the existing services and obtain his approval/ cooperation in the matter. All shutdowns of the electrical services installation shall be carried out during 'Out of Hours' operating times as agreed with the Client.
- Patients and staff will remain in occupation during the project due to the nature of the demise. As such, all noisy works shall only commence after 9.00am, or, at a time agreed with the Client.
- Provide complete method statements to the Client and Engineer at least 5 working days in advance of any shutdown. The method statement shall detail items such as the powering down of any essential equipment and provide temporary supplies to keep them running (as agreed with the Client) during any shutdown.

B1.16 Site Waste Management Plan (SWMP)

The Contractor shall ensure that all materials brought onto the site are from sustainable sources or have a high level of recycled content; in particular the following must be adhered to:

- All timber used shall be FSC and evidence to support this must be included in the SWMP.
- All materials used shall have a recycled content in the top 25% achievable for the particular component.
- All suppliers will be encouraged and expected to minimise packaging used for materials delivered to site.
- All redundant electrical fixtures and fittings, tubes and lamps shall be removed by the respective supplier in accordance with the WEEE Regulations.

Where possible all redundant equipment, switchgear, luminaries accessories etc... shall be recycled.

Any packaging shall be of the recyclable type and the Contractor shall prepare and maintain a simple table listing:

- Waste carrier, recording name, licence details, including number and expiry date.
- Waste facility, recording name, type of facility, recycled percentage, licence or exemption number.

B1.17 Completion of Works**Cleaning**

On completion of the works, or a section of the works, the Contractor shall, in good time prior to inspection and handover:

- Make good all damage consequent upon the works.
- Remove all temporary markings, covering and protective wrappings unless otherwise instructed.
- Clean the works thoroughly inside and out including all accessible ducts and voids, remove all splashes deposits, rubbish and surplus materials consequent upon the execution of the work.
- Cleaning materials and methods to be as recommended by manufacturers of products being cleaned and to be such that there is no damage or disfigurement to

- other materials or construction.
- Remove all tools, plant and equipment and extraneous items not forming part of the completed installation.

Setting to Work

The Contractor shall provide attendance during the testing and commissioning of all plant and equipment connected with the works.

The testing and commissioning will commence when the Contractor is satisfied that the whole of the works is complete with all accessories, components, spare parts etc., specified together with all the updated installation drawings.

In the event of a section of the works being completed prior to the commencement of the testing and commissioning period the Contractor may apply to the Engineer for approval to commence testing and commissioning of that section of works in advance of the testing and commissioning period.

Working Construction Drawings and As Installed Drawings

The Contractor shall note that the tender drawings are design intent drawings only and shall be developed into Construction Issue drawings from site dimensions and manufacturers' certified drawings and information.

The Contractor shall be responsible for the production of coordinated drawings. Coordination shall take into account all existing services, electrical, mechanical and drainage where applicable.

The Contractor shall maintain on site and update on a weekly basis or as appropriate, a copy of each installation drawing incorporating all changes and modifications. It is from these updated installation drawings that the Contractor shall prepare the As Installed drawings.

The updated installation drawings are to be available for inspection at all times throughout the contract period.

The Contractor shall include on the updated installation drawings all cable identifications, plant identifications, duties, settings and cross references for other drawings and documentation.

The 'As Installed' drawings shall be produced on AutoCAD and the Contractor shall submit one 'original size' set with each O&M manual. The Contractor shall also submit all 'As Installed' drawings via electronic transfer in AutoCAD '.dwg' and '.pdf' formats.

Operating and Maintenance Manuals

The Contractor shall prepare the draft, provisional and final versions of the operating and maintenance manuals to meet the stipulated dates. Two sets of the final versions shall be submitted.

The Manuals shall also include copies of all test certificates. The Contractor shall hand over all test certificates progressively as tests are witnessed to the satisfaction of the Engineer.

A draft operation and maintenance manual shall be provided for approval prior to the project programmed handover date.

All handover information shall be in accordance with BSRIA publication TN15/95

Acceptance and Handover

At the end of the testing and commissioning period provided the Engineer is satisfied that the installation is in full working order, the Contractor shall attend a formal handover meeting to be arranged to place the installation in the keeping of the Client.

The date of acceptance of the installation will be the date of issue of the certificate of practical completion. The Contractor shall prepare a certificate of completion and inspection for forwarding by the Engineer to the Client for acceptance.

Equipment Warranties

The Contractor shall ensure that all manufacturers' equipment warranties are to run for a minimum of 12 months from the date of practical completion.

Emergency Repairs and Maintenance

The Contractor shall provide an emergency call out provision to attend to any emergency or defect for the 12 month defect period on the installation on the following basis:

- Emergency defect: Attend site within 4 hours of the call.
- Urgent repair: Attend site within 24 hours of the call.
- Non-urgent repair: Attend site within 7 days of the call.

All costs associated with providing an emergency and breakdown service on the new installation shall be allowed within the Tender sum.

The Contractor shall be responsible for routine maintenance during the 12 months defects liability period.

Making Good Defects

The Contractor shall arrange with the Client and Engineer and give reasonable notice of the precise dates for access to various parts of the works for the purposes of making good defects. The Contractor shall also inform the Engineer when remedial works to the various parts of the works are completed.

B1.18 Inspection and Measurement of Work

The Contractor shall give all assistance necessary to enable the Engineer to examine or measure the works and shall not cover, conceal or insulate any section of the works before completion of a satisfactory and witnessed test.

Any work which has to be redone due to concealment and lack of inspection shall be at the Contractors' own expense.

The Contractor shall give the Engineer 1 weeks' notice of any inspection and tests and at least 2 weeks' notice of the anticipated dates of practical completion.

The Contractor shall obtain signed certificates of all witnessed tests. The certificates shall be signed by the Engineer of his designated representative.

B1.19 Security and Safety**Security**

The Contractor shall adequately safeguard the site, the works, products, materials, plant and any existing buildings affected by the works from damage, fire or theft.

Safety

Take all necessary precautions to prevent nuisance and effect from smoke, dust, rubbish, vermin and other causes.

Fire Precautions

The Contractor shall take all necessary precautions to prevent personal injury, death and damage to the works or other property from fire. Comply with the Joint Code of Practice Fire Prevention on Construction Sites 1992 published by the Building Employers confederation, the Loss Prevention Council and The National Contractors' Group. Allow for maintaining the integrity of all existing fire escape routes and fire protection systems during the works.

The Main Contractors' employees, including managerial staff, who are employed for any period of time whatsoever within the premises are to ensure that they read and sign the Fire and Emergency Instructions where applicable.

In addition to the requirements of the relevant Acts and Regulations relating to the prevention of the outbreak of fire on building sites within occupied buildings, the Contractor is to ensure that no accumulation of combustible debris occurs. Furthermore, the Engineer shall ensure that any potentially hazardous works are discussed and agreed with the Contractor prior to their commencement. Any necessary hot work must be certified and should be completed at least 60 minutes before the cessation of works for the day.

Remove waste rubbish, debris and surplus material as it accumulates and keep the works clean and tidy at all times.

B1.20 Approval

The Engineers' approval shall not relieve the Contractor of their contractual responsibilities and obligations. The Contractor shall be responsible for discrepancies, errors or omissions on drawings or other documentation supplied by them, whether they have been approved by the Engineer or not, provided such discrepancies, errors or omissions are not due to incorrect information given in writing by the Engineer.

PART C – Description of Work

C1 The Works

C1.1 Mechanical Survey/ Validation

The Contractor shall be responsible for carrying out a full mechanical survey/ validation prior to commencing any strip out/ fit out works on site.

This shall be carried out to ensure that the existing relevant mechanical services are in full working order, and shall include the following:

- Existing supply and extract ventilation systems.
- Existing CT heating circuit operation and measurement of flow rates.
- Existing Chilled water circuit operation and measurement of flow rates.

Employ a specialist to analyse the existing LTHW, and chilled water systems, and provide a report with findings, including recommended water treatment for new services.

Employ a specialist to draw up a method statement to advise on the treatment of water used for flushing and pressure testing to prevent the contamination of the LTHW and Chilled Water systems with pseudomonas. A pseudomonas method statement shall be provided as based on BSRIA AG 1/2001. All water supplies shall be sampled and analysed to establish its quality and the presence of bacterial contamination before filling any system. A water quality analysis report shall be submitted.

The Contractor shall submit their survey findings/ results at the earliest possible opportunity to the client/ design team for review.

C1.2 Strip-Out Works & Protection of Live Services

The Contractor shall be responsible for carrying out the strip out of the existing redundant mechanical services, generally as indicated on the tender drawings.

The surveys and validations shall be carried out to ensure that the existing relevant mechanical services are in full working order and to investigate areas that might be served by existing systems not reflected on the Tender drawings.

The Contractor shall submit their survey findings/ results at the earliest possible opportunity to the client/ design team for review in the form of drawings & validation report.

The contractor shall protect the existing services that feed other areas.

C1.3 Plant Support

The Contractor shall:

Employ specialist
Roof-Pro
Polwell Lane
Burton Latimer
Kettering
NN15 5PS

To design, supply and install, new air handling unit support platforms with maintenance platforms.

Ensure that calculations from Roof Pro are submitted to the structural engineer Elvin Gomery at

COWAN CONSULTANCY Ltd,
3 Turnberry House
4400 Parkway
Whiteley
Fareham
Hampshire
PO15 7FJ

For approval, prior to installation of the plant support platform.

C1.4 Ventilation

C1.4.1 West Wing Ventilation

The Contractor shall:

Supply, install, test and commission 1 no. new externally mounted air handling unit ref AHU01 as indicated in the enclosed equipment schedule, quotation E190816 as supplied by Dalair.

Supply 'Tico' pad, to site between the AHU01 and the supporting steelwork to absorb any residual vibration.

Supply, install, test and commission new supply and extract ductwork to DW144 class A, and ensure that all ends of ductwork are properly sealed at the end of each work day. , grilles and diffusers, plenum boxes, etc.

Test and commission.

Provide clinical ductwork cleaning to the new supply and return air ductwork systems by a specialist Contractor.

It is the Contractors' responsibility to ensure that all new ductwork systems meet the bacteriological and cleanliness levels required.

Clean and sterilise the new air handling units, as indicated in HTM 0301. Checking validation and certification procedures shall be in place.

Provide and erect ductwork to DW144, plenum boxes, control dampers, grilles, diffusers etc., to form complete air supply distribution and exhaust systems and leave the installation adjusted to the designed air quantities.

Ensure ductwork is manufactured as far as is practicable to site dimensions taken by the Contractor. Where site dimensions cannot be taken in advance, dimensions shall be taken from Architectural/Structural detail dimensioned drawings and the Contractor shall make suitable provisions to accommodate any discrepancies that may occur between the drawings and site dimensions.

Carry out pressure testing, clinical cleaning and commissioning of ventilation systems.

Supply and install insulation to all ductwork, including "Venture Clad" on external ductwork.

Commissioning and balancing new system, to achieve existing flow rates measured during the validation process

C1.4.2 East Wing Ventilation

The Contractor shall:

Supply, install, test and commission 1 no. new externally mounted air handling unit ref AHU02 as indicated in the enclosed equipment schedule, quotation ref E190816 as supplied by Dalair.

Supply 'Tico' pad, to site between the AHU01 and the supporting steelwork to absorb any residual vibration.

Supply, install, test and commission new supply and extract ductwork to DW144 class A, and ensure that all ends of ductwork are properly sealed at the end of each work day.
, grilles and diffusers, plenum boxes, etc.

Commissioning and balancing new system, to achieve existing flow rates measured during the validation process

Provide clinical ductwork cleaning to the new supply and return air ductwork systems by a specialist Contractor.

It is the Contractors' responsibility to ensure that all ductwork systems serving the above areas meet the bacteriological and cleanliness levels required.

Clean and sterilise the new air handling units, as indicated in HTM 0301. Checking validation and certification procedures shall be in place.

Provide and erect ductwork to DW144, plenum boxes, attenuators, control dampers, grilles, diffusers etc., to form complete air supply distribution and exhaust systems and leave the installation adjusted to the designed air quantities.

Ensure ductwork is manufactured as far as is practicable to site dimensions taken by the Contractor. Where site dimensions cannot be taken in advance, dimensions shall be taken from Architectural/Structural detail dimensioned drawings and the Contractor shall make suitable provisions to accommodate any discrepancies that may occur between the drawings and site dimensions.

Carry out pressure testing, clinical cleaning and commissioning of ventilation systems.

Supply and install insulation to all ductwork, including "Venture Clad" on external ductwork.

C1.5 Chilled Water

The Contractor shall:

Supply, install, test and commission new chilled water pipework to serve AHU 01, connecting to existing pipework in west plantroom only.

Design, supply, install, test and commission the new pipework system using pre-insulated Cool Fit ABS Plus pipework, fittings and supports as manufactured by Georg Fischer.

Supply, install, test and commission new chilled water pressurisation unit and expansion vessel, valves as shown on the Tender drawings.

Supply, install, test and commission condensate drainage with self-sealing waste valves and trapped tundishes discharging to waste.

Pressure test, clean, dose, commission, including adding Glycol to the existing chilled water system if required following validation of existing concentration levels. Insulate and vapour seal, including insulation jackets and vapour sealing of all valves.

Dose and vent and commission new Chilled Water systems.

C1.6 LTHW System

The Contractor shall:

Supply, install, test and commission new LTHW circuits from east and west roof plantroom, to serve new air handling units AHU01 and AHU02.

Supply, install, test and commission trace heating, to external LTHW pipework.

Pressure test. Dose and vent and commission new LTHW system.
Insulate pipework in Rockwool, and provide insulation jackets to all valves.

C1.6.1 Flushing Valve

The Contractor shall:

- Provide where required flushing bypass valves located as close as possible to the item of equipment being protected.
- Padlock the flushing valve in the closed position on satisfactory completion of the total system flushing.
- Comply with the procedures set out in BSRIA Application Guide 8/91 – Pre-commissioning and cleaning of water systems.
- Provide full bore dirt pockets with drain off valves at the base of each pipe riser.
- Arrange for all pipework to be self-draining.
- Provide for low pressure hot water heating systems to be chemically cleaned to remove ferrous oxide, dirt and foreign matter. The treatment shall include chemical coating of the metal surfaces and shall be carried out by a specialist experienced in this type of work.
- Provide a programme and method statement and obtain approval from the Contract Administrator prior to the work being started.
- Ensure that flushing out and draining is carried out according to the recommendations set out in BSRIA – Application Guide 8/91 – Pre-commission Cleaning of Water Systems.

C1.7 Central Control/ Building Management**C1.7.1 General**

The Contractor shall:

Appoint the incumbent BMS specialist, Intandem Systems Ltd to supply, install test and commission new BMS controls, including:

Contact: George Belfield, george@intandem.org.uk , 01489 877630.
www.intandem.org.uk

InTandem Systems Ltd
Unit D,
Watton Farm
Watton Lane
Droxford
Southampton
Hampshire
SO32 3HA

To supply, install test and commission new BMS controls:

- 2 no. new mechanical services control panels, MSCP01 & MSCP02
- New Cat 5 data cabling to link outstations to site wide infrastructure

MSCP01 to serve AHU No.1 and be located in the existing East Wing Plantroom

MSCP02 to serve AHU No.2 and be located in the existing West Wing Plantroom

Allow for link between BMS and fire alarm panel.

Employ incumbent fire alarm specialist, Element Fire to supply and install a new fire alarm interface at each control panel.

Update existing head end with graphics for new ventilation plant.

C1.7.2 Mechanical Services Control Panel MSCP01

The mechanical services control panel MSCP01 shall provide power and controls to the following:

AHU 01

System Ref. West Wing Ventilation System AHU01**Components:**Supply Side

Supply Air Inlet Damper
Panel Filters G4
Supply fan run "EC Plug Fans" (Duty share 50%/50%)
Isolation dampers
Recuperator damper
Supply Air Outlet

Extract Side

Panel filter
Recuperator
Supply fan run "EC Plug Fans" (Duty share 50%/50%)

Functional Control:

AHU01 shall be programmed for start / stop under control of the BMS: all controls activated on start up.

A temperature sensor shall operate a 3 port normally open valve on the frost coil at temperatures of 5 °C and below.

A hand reset freeze protection thermostat, having its sensitive element located across the downstream face of the frost coil shall de-energise power to the fans in the event of sensing temperatures of 3 °C and below. On this condition, the valve shall move to the open position and an alarm raised at the head end.

The frost coil shall be controlled via the BMS software.

A duct mounted discharge air temperature sensor shall control, in sequence, the recuperator face and by-pass dampers, the cooling coil 3 port control valve, or the main heating coil 3 port valve.

The dead-band between the operation of the cooling and heating coils shall be adjustable, but shall be pre-set to the following:-

- Heating off when outside is 15 °C or greater.
- Cooling coil off when outside is 18 °C or less.
- The controls shall limit the discharge temperature in the range 15 to 21 °C.
- The air discharge temperature shall be set at 18 °C during winter
- Alarms shall be raised at the head end if discharge temperature is less than 10°C and greater than 23 °C.

Differential pressure sensor switches shall be provided across each filter bank. The BMS shall monitor each differential pressure. An alarm shall be raised at the head end and at the local panel in the event of a differential pressure exceeding its pre-set value.

A differential pressure transmitter located in the supply duct shall via a controller, if required maintain the supply duct static pressure by adjusting fan speed.

Volumetric tracking of supply / return fans shall be achieved by linear air velocity transmitters via a controller operating the return fan inverter.

Smoke detectors in the main supply and return air ducts, when activated shall shut down the air handling unit and activate the fire alarm panel.

System Ref: - Fire/Smoke damper Panel interface

The contractor shall liaise with Actionair to ensure that a suitable interface is allowed for between the BMS and the Fire/Smoke damper panel.

C1.6.3 Mechanical Services Control Panel MSCP02

System Ref. East Wing Ventilation System AHU02

Components:

Supply Side

Supply Air Inlet Damper
Panel Filters G4
Supply fan run "EC Plug Fans" (Duty share 50%/50%)
Isolation dampers
Recuperator damper
Supply Air Outlet

Extract Side

Panel filter
Recuperator
Supply fan run "EC Plug Fans" (Duty share 50%/50%)

Functional Control:

AHU01 shall be programmed for start / stop under control of the BMS: all controls activated on start up.

A temperature sensor shall operate a 3 port normally open valve on the frost coil at temperatures of 5 °C and below.

A hand reset freeze protection thermostat, having its sensitive element located across the downstream face of the frost coil shall de-energise power to the fans in the event of sensing temperatures of 3 °C and below. On this condition, the valve shall move to the open position and an alarm raised at the head end.

The frost coil shall be controlled via the BMS software.

A duct mounted discharge air temperature sensor shall control, in sequence, the recuperator face and by-pass dampers, the cooling coil 3 port control valve, or the main heating coil 3 port valve.

The dead-band between the operation of the cooling and heating coils shall be adjustable, but shall be pre-set to the following:-

- Heating off when outside is 15 °C or greater.
- Cooling coil off when outside is 18 °C or less.
- The controls shall limit the discharge temperature in the range 15 to 21 °C.
- The air discharge temperature shall be set at 18 °C during winter
- Alarms shall be raised at the head end if discharge temperature is less than 10°C and greater than 23 °C.

Differential pressure sensor switches shall be provided across each filter bank. The BMS shall monitor each differential pressure. An alarm shall be raised at the head end and at the local panel in the event of a differential pressure exceeding its pre-set value.

A differential pressure transmitter located in the supply duct shall via a controller, if required maintain the supply duct static pressure by adjusting fan speed.

Volumetric tracking of supply / return fans shall be achieved by linear air velocity transmitters via a controller operating the return fan inverter.

Smoke detectors in the main supply and return air ducts, when activated shall shut down the air handling unit and activate the fire alarm panel.

BMS Points Schedule:

MSCP01 West Wing Plantroom	Point					Notes
	DI	AI	PI	DO	AO	
Description						
Air Handling Unit AHU01						
Supply Air Damper Open/Close				1		
Supply air damper end switch	1					
Fresh air duct temp. sensor		1				
Fresh air duct smoke sensor	1					
LTHW Frost Coil 3 port valve					1	Control valve by controls specialist
Frost Temp		1				
Frost Hold Off Temp		1				
Panel Filter Press		1				Diff pressure sensor
Bag Filter Dirty	1					Diff pressure sensor
CHW Cooling Coil 3 port valve					1	
LTHW Re-heater 3 port valve					1	
Supply Air Fans On/Off and Speed Control					2	Panel mounted inverter x 2
Supply Air Fan Running	1					DP Switch
Supply Air Fan Fault	1					
Supply Duct Temperature Sensor		1				
Duct Pressure Sensor		1				
Linear velocity supply sensor		1				
Linear velocity return sensor		1				
Panel Filter Dirty	1					
Extract Duct temp sensor		1				
Extract fans on/off and speed control					2	Panel mounted inverter 2 no.
Extract fan running	1					
Extract Damper open/closing				1		
Outdoor temperature		1				
Smoke sensor supply & extract ducts	2					
Fire Alarm						
Fire alarm link				1		

MSCP02 East Wing Plantroom Description	Point					Notes
	DI	AI	PI	DO	AO	
Air Handling Unit AHU02						
Supply Air Damper Open/Close				1		
Supply air damper end switch	1					
Fresh air duct temp. sensor		1				
Fresh air duct smoke sensor	1					
LTHW Frost Coil 3 port valve					1	Control valve by controls specialist
Frost Temp		1				
Frost Hold Off Temp		1				
Panel Filter Press		1				Diff pressure sensor
Bag Filter Dirty	1					Diff pressure sensor
CHW Cooling Coil 3 port valve					1	
LTHW Re-heater 3 port valve					1	
Supply Air Fans On/Off and Speed Control					2	Panel mounted inverter x 2
Supply Air Fan Running	1					DP Switch
Supply Air Fan Fault	1					
Supply Duct Temperature Sensor		1				
Duct Pressure Sensor		1				
Linear velocity supply sensor		1				
Linear velocity return sensor		1				
Panel Filter Dirty	1					
Extract Duct temp sensor		1				
Extract fans on/off and speed control					2	Panel mounted inverter 2 no.
Extract fan running	1					
Extract Damper open/closing				1		
Outdoor temperature		1				
Smoke sensor supply & extract ducts	2					
Fire Alarm						
Fire alarm link				1		

C1.7 Electrical Services

Although requiring a survey/ verification, it appears that the existing mechanical control panels currently installed within the East and West roof level plant rooms are served from dedicated 63A TPN MCCB's installed within the Ground Floor Plantroom LV Switch Panel, 'DBM'. There appear to be 3 number outgoing 63A TPN supplies, fed via outgoing ways 7L123, 8L123 and 9L123, of which 2 should serve the mechanical control panels. It is not known where the location of the 3rd mechanical control panel is located. The electrical contractor shall survey and verify which supply serves which control panel prior to commencing any other works.

Each outgoing way appears to serve 16mm² 5C XLPE/SWA/LSF cables, serving the control panels within the roof level plant rooms.

The existing mechanical control panels currently serve fans located within the plant areas associated with the mechanical equipment. It is the intent to replace the existing mechanical control panels with new units as described within this specification. The electrical contractor shall be responsible for transferring the existing supplies currently served via the existing mechanical control panels across to the new mechanical control panels as well as providing new supplies to the new AHU's (Air Handling Units) being installed. Again, the electrical contractor shall survey and verify the exact quantity of existing supplies that require transferring over from the old panels to the new. The electrical contractor shall liaise with the mechanical contractor to determine when the transfer of existing supplies can take place.

The new mechanical control panels shall also serve new AHU's being installed on the roof outside each of the plant rooms. Each AHU has dual supply and dual extract fans and therefore require 4 supplies per AHU. The electrical contractor shall supply, install, test and commission the following supplies from the mechanical control panels:

AHU 01:

Supply fan No. 1: 6A TPN MCB feeding 6A TPN Rotary IP isolator via 2.5mm² 5C XLPE/SWA/LSF
Supply fan No. 2: 6A TPN MCB feeding 6A TPN Rotary IP isolator via 2.5mm² 5C XLPE/SWA/LSF

Extract fan No. 1: 6A TPN MCB feeding 6A TPN Rotary IP isolator via 2.5mm² 5C XLPE/SWA/LSF
Extract fan No. 2: 6A TPN MCB feeding 6A TPN Rotary IP isolator via 2.5mm² 5C XLPE/SWA/LSF

AHU 02:

Supply fan No. 1: 10A TPN MCB feeding 10A TPN Rotary IP isolator via 4.0mm² 5C XLPE/SWA/LSF
Supply fan No. 2: 10A TPN MCB feeding 10A TPN Rotary IP isolator via 4.0mm² 5C XLPE/SWA/LSF

Extract fan No. 1: 6A TPN MCB feeding 6A TPN Rotary IP isolator via 2.5mm² 5C XLPE/SWA/LSF
Extract fan No. 2: 6A TPN MCB feeding 6A TPN Rotary IP isolator via 2.5mm² 5C XLPE/SWA/LSF

(Note: All MCB's shall be Type C – All calculations are based on cable runs of up to 40m – All sub main cabling running out from the plant rooms to serve the AHU's shall be provided with suitable galvanised cable tray, supplied and installed by the electrical contractor).

All isolators feeding AHU's shall be mounted on unistrut adjacent to the AHU they serve in a position agreed with the Client and mechanical contractor.

The electrical contractor shall note that the installation of new cable tray, isolators, sub main cabling etc. shall be carried out prior to the actual shut down of the existing mechanical control panel. This shall be deemed as enabling works, to ensure that the shutdown period of the existing mechanical control panel, transfer of existing circuits from old panel to new and installation of new supplies feeding the new AHU's is kept to a bare minimal timescale.

Due to the fact that the existing mechanical control panels will need to be isolated (shutdown) to facilitate the removal of old ductwork and fans by the mechanical contractor, and the installation of new, the electrical contractor will liaise with the mechanical contractor to determine when the electrical works can be undertaken.

Once a programme for the works has been agreed with all parties, including the Client, it shall form a part of the electrical contractors' works to isolate the existing mechanical control panels, disconnect them and re-use the existing cabling currently serving them to connect to the new mechanical control panels.

The electrical contractor shall employ the Clients' preferred specialist Messrs. Element to supply, install, test and commission new Fire Alarm interface devices to each mechanical control panel.

Contact:

Carl Wise
Tel: 08456 121314
Mob: 07789 728158
Email: carlwise@elementfacilities.co.uk

It shall be noted that no isolations or shut-downs shall occur without former agreement from the Client during the course of these works. Plant areas shall remain protected via the fire alarm system during the course of the works also.

C1.8 Fire Stopping

The contractor shall supply, install, test and commission suitable means of fire stopping where services penetrate floors, slabs, walls etc. which are fire resisting constructions, to ensure that the construction/ system works to its maximum ability, to save life and property.

Installations/ services must be tested in accordance with the test methods set out in appropriate standards. Tests are to be carried out in accordance with the general principles of BS476: Part 20: 1987 or BS EN 1366-3: 2004 and BS EN 1366-4: 2006.

The contractor shall be responsible for determining the best/ correct method of fire stopping for each individual service penetration through fire rated constructions. The contractor shall review each individual penetration and make consideration for the following prior to choosing the final method(s) of fire stopping:

- Fire resistance period. (30 – 240 minutes).
- Wall, Floor, Gap etc.
- Ambient conditions.
- Potential movement/ vibration
- Mechanical strength/ loadbearing required.
- Insulation requirement.
- Thermal expansion, flexibility of seals.
- Smoke or gas tightness.

To aid in ascertaining the correct method of fire stopping, it is advised that the contractor refer to manufacturers/ guides for further information/ advice, as provided by Messrs.:

Promat UK Limited
The Sterling Centre,
Eastern Road,
Bracknell,
Berkshire,
RG12 2TD

Telephone: 01344 381 300
Website: www.promat.co.uk

(Or manufacturers/ guides equal or approved).

The contractor shall review each individual service penetration in conjunction with the fire safety plan (as generally provided within the Architectural design package) to ensure that they

are satisfied all penetrations through fire rated walls/ slabs/ floors etc. are identified for fire stopping. Should the contractor have any questions regarding certain constructions (what rating they may be or whether they are fire rated), then the contractor shall be responsible for approaching the Client/ Architect/ CA/ Fire officer for definitive confirmation.

Upon finalising all service penetrations requiring fire stopping and having chosen suitable methods of fire stopping for each example, the contractor shall schedule this information and issue to Building Control/ Fire Officer for approval prior to installation.

PART D – Project Particular Materials/ Schedules

D1 Mechanical

D1.1 Pipework Materials

D1.1.1 Heating & Chilled water

Heating:

Mild steel heavy quality BS EN10255, screwed ends to BS EN 10266-1:2004 taper, black varnished finish. Fittings Malleable cast iron to BS 143 & BS 1256 or BS EN 10242. Finish - Black.

Jointing: Threaded to BS 21 and BS EN 10226-1.

Use PTFE tape to BS 7786.

Chilled Water:

Pre-insulated Cool Fit ABS Plus pipework, fittings and supports as manufactured by George Fischer.

D1.2 Ductwork

D1.2.1 General Ventilation

Sheet metal to HVAC/DW144 low pressure.

D1.3 Thermal Insulation

Pipes to be insulated with 20mm thick ROCKWOOL RockLap H&V Pipe Sections, having a nominal density not less than 120 kg/m³, with a factory applied facing which is a laminate of close mesh reinforcement between two layers of foil including integral lap for fixing. The whole to comply with BS5422:2009 and BS 5970 water vapour permeance and Building Regulations Class O definition. Fixing to be in accordance with manufacturer's instructions, by peeling protective tape from self-adhesive lap and pressing lap smoothly over joint. Where adjacent Sections abut, approved 75 mm wide aluminium tape to be used to maintain integrity of the vapour barrier.

<p>Recuperator</p>	<p>Type Plate Heat Exchanger Supply Air On 5 °C /Supply Air Off 18.7 °C Extract Air On Db 22 °C /Extract Air On RH 50 % Efficiency (Sup) 80.5 % Heat Recovered 42.5 kW Special Features Face & By-pass Damper, Epoxy Coated Protected</p>
<p>CW Cooler</p>	<p>Volume 2.56 m³/s Air On Coil Db 30 °C/ Air On Coil Wb 22 °C Air Off Coil Db 10 °C/ Air Off Coil Wb 9.9 °C Duty 107.8 kW /Face velocity 2.0 m/s Medium Chilled Water /Flow Temp 6 °C /Return Temp 12 °C Flow Rate 4.282 l/s /Water Pd 35 KPa Rows/Fins 7R/10F /No of Sections 1 Construction Copper/PreTinned /Eliminators YES / / Stainless steel casework Drain Pan Removable</p>
<p>LTHW Heater</p>	<p>Volume 2.56 m³/s Air On Coil Db 5 °C /Air Off Coil Db 21 °C Duty 49.6 kW /Face velocity 2 m/s Medium LTHW /Flow Temp 82 °C /Return Temp 71 °C Flow Rate 1.104 l/s Water Pd 10 KPa /Rows/Fins 1R/8F No of Sections 1 Construction Copper/Copper / / Stainless steel casework</p>
<p>Bag filters</p>	<p>Type Bag – Hi Flo M Series Efficiency M7, eMP1 60%. Arrangement 3W x 1.5H Withdrawal Front /Manometer Magnahelic</p>
<p>Supply Air Outlet</p>	<p>Damper (Damper Seals:- Side & Blade) Air Volume 2.56 m³/s</p>
<p>Extract Fan</p>	<p>Extract Fan"EC Plug Fans" Duty/Share 50%/50% Volume 2.56 m³/s /External static 350 Pa Absorbed power Motor power Fan type 2 x PLUG / Backward curved / Direct driven / Dual fans Fan speed 2430 RPM Total fan efficiency 58 % Electrical Supply 400V-3Ph-50Hz Fan discharge SWL levels 63 125 250 500 1000 2000 4000 8000 (Hz) 77 77 84 83 86 86 81 75 Including adjustment for dual fan arrangement Includes +4dB fan in casework adjustment Door guard fitted? YES Isolator fitted? YES Standby motor fitted? NO Thermistors fitted? YES Damper (Damper Seals:- Side & Blade)manual quadrant Air Volume 2.56 m³/s</p>

M5 Panel Filters	Type Panel Efficiency 50mm 40/40 Panel M5/Coarse 80% Arrangement 3W x 1.5H Withdrawal Front Manometer Magnahelic
Recuperator (2018 Compliant) Extract Air Outlet	Damper (Damper Seals:- Side & Blade) Air Volume 2.56m ³ /s

Quotation E190816 A as manufactured by Dalair

Ref	AHU02
Item	Supply Side
Components	Supply Air Inlet Damper – Epoxy Coated, Actuator Mounted Out Off Airstream. Service Access LTHW Frost Coil (bare tube) Panel Filters G4 – Metal Frame Front Withdrawal. Supply fan run “EC Plug Fans” Duty/Share Each Plugfan 50% / 50% Service Access Section Recuperator (2018 Compliant) Service Access Section CW Cooler Service Access Section LPHW Heater Service Access Section Bag Filters – High Flo M7 635mm, Front withdrawal. Supply Air Outlet – Manual Hand Quadrant.
Frost Coil	<u>Frost coil</u> Volume 4.41 m ³ /s Air On Coil Db -5 °C Air Off Coil Db 5 °C Duty 53.4 kW/ Face velocity 2 m/s LTHW/ Flow Temp 82 °C/Return Temp 71 °C LTHW Flow Rate 1.189 l/s/ Water Pd 15 KPa Rows/Fins 4R/0F/ No of Sections 1 Construction Plain Copper Tube / Stainless steel casework
Panel Filter	Type Panel Metal Frame Efficiency G4 Arrangement 4W x 2H Withdrawal Front Manometer Magnahelic
Supply Fan	Supply Fan“EC Plug Fans” Duty/Share 50%/50% Volume 4.41 m ³ /s /External static 350 Pa Absorbed power Motor power Fan type 2 x PLUG / Backward curved / Direct driven / Dual fans Fan speed 2212 RPM /Total fan efficiency 53 % Electrical Supply 400V-3Ph-50Hz

	<p>Fan discharge SWL levels 63 125 250 500 1000 2000 4000 8000 (Hz) 87 87 97 94 92 88 87 82</p> <p>Including adjustment for dual fan arrangement Includes +4dB fan in casework adjustment Door guard fitted? YES Isolator fitted? YES /Standby motor fitted? NO /Thermistors fitted? YES</p>
Recuperator	<p>Type Plate Heat Exchanger Supply Air On 5 °C /Supply Air Off 19.7 °C Extract Air On Db 22 °C /Extract Air On RH 50 % Efficiency (Sup) 86.7 % Heat Recovered 78.9 kW Special Features Face & By-pass Damper, Epoxy Coated</p>
CW Cooler	<p>Volume 4.41 m³/s Air On Coil Db 30 °C/ Air On Coil Wb 22 °C Air Off Coil Db 10 °C/ Air Off Coil Wb 9.9 °C Duty 185.7 kW /Face velocity 1.9 m/s Medium Chilled Water /Flow Temp 6 °C /Return Temp 12 °C Flow Rate 7.377 l/s /Water Pd 30 KPa Rows/Fins 7R/10F /No of Sections 1 Construction Copper/PreTinned /Eliminators YES / Stainless steel casework Drain Pan Removable</p>
LTHW Heater	<p>Volume 4.41 m³/s Air On Coil Db 5 °C /Air Off Coil Db 21 °C Duty 85.5 kW /Face velocity 1.9 m/s Medium LTHW /Flow Temp 82 °C /Return Temp 71 °C Flow Rate 1.902l/s Water Pd 15 KPa /Rows/Fins 1R/8F No of Sections 1 Construction Copper/Copper / Stainless steel casework</p>
Bag filters	<p>Type Bag – Hi Flo M Series Efficiency M7, eMP1 60% Arrangement 4W x 2H Withdrawal Front Manometer Magnahelic</p>
Supply Air Outlet	<p>Damper (Damper Seals:- Side & Blade) Air Volume 4.41 m³/s</p>
Extract Fan	<p>Extract Fan"EC Plug Fans" Duty/Share 50%/50% Volume 5.14 m³/s /External static 350 Pa Absorbed power Motor power Fan type 2 x PLUG / Backward curved / Direct driven / Dual fans Fan speed 1966 RPM Total fan efficiency 62 % Electrical Supply 400V-3Ph-50Hz Fan discharge SWL levels 63 125 250 500 1000 2000 4000 8000 (Hz) 78 78 86 86 87 82 79 74</p> <p>Including adjustment for dual fan arrangement Includes +4dB fan in casework adjustment Door guard fitted? YES</p>

	<p>Isolator fitted? YES Standby motor fitted? NO Thermistors fitted? YES</p> <p>Damper (Damper Seals:- Side & Blade) Air Volume 5.14 m³/s</p>
M5 Panel Filters	<p>Type Panel Efficiency 50mm 40/40 Panel M5 / Coarse 80% Arrangement 4W x 2H Withdrawal Front Manometer Magnahelic</p>
Recuperator (2018 Compliant) Extract Air Outlet	<p>Damper (Damper Seals:- Side & Blade) Air Volume 5.14m³/s</p>

Additional Notes.

- AHU framework - Powdercoated Steel c/w insulated framework.
- AHU panels Advantica coated steel lined inner skin.
- Powdercoated dampers c/w side & tip seals.
- FAI / Exhaust outlet dampers c/w extended damper spindles with Actuator enclosures fitted out of the air stream.
- Powdercoated filter & coil slides.
- Dual plugfans fitted side by side. Access required to both sides of AHU's.
- Galvanised conduit fitted on non-access side out of the air stream.

D1.5 LTHW/Chilled Water/

Isolation

Size	Type	Manufacturer	Figure
DN15 - DN50	Optical DZR Ball Valve Lever Operated Screwed BSP	Oventrop	107 90
DN15 - DN50	Optical DZR Ball Valve Extended T Handle Screwed BSP	Oventrop	107 91
DN15 - DN50	Optibal DZR Ball Valve Lockshield Pattern Screwed BSP	Oventrop	107 92
DN15 & DN20 Only	Optibal DZR Ball Valve T Handle Operated Screwed BSP	Oventrop	107 94
15mm - 54mm	Optibal DZR Ball Valve Compression ends Lever Operated	Oventrop	107 95
15mm & 22mm Only	Optibal DZR Ball Valve Compression ends T Handle Operated	Oventrop	107 96
15mm - 54mm	Optibal DZR Ball Valve Compression ends Extended T Handle Operated	Oventrop	107 97
15mm - 54mm	Optibal DZR Ball Compression ends Lockshield Pattern	Oventrop	107 99

Double Regulating Valves

Size	Type	Manufacturer	Figure
DN15 - DN50	Hydrocontrol DRV Bronze Body PN16 @ - 20 to + 150 BS 7350	Oventrop	106 01
DN15 only	Bronze Low Flow DRV Low Flow BS 7350 (0.01- 0.035 L/S)	Oventrop	106 11 64

D1.6 LTHW/Commissioning Sets/Motorized Valves

Commissioning Stations

Ref	Location	Serving/Flow Rate /Size/Signal (KPa)	Manufacturer	Model
CS01	Roof AHU01	FROST LTHW/0.69/32mm	Crane	D931
CS02	Roof AHU01	CHW/4.3/65mm	Crane	D931
CS03	Roof AHU01	REHEAT LTHW/1.1/40mm	Crane	D931
CS04	Roof AHU02	FROST LTHW/1.19/40mm	Crane	D931
CS05	Roof AHU02	REHEAT LTHW/1.9/50mm	Crane	D931

Motorised valves Water

Ref	Line Size Ø(mm)	Flow l/s	Ports	Function
MV01	32	0.69	3	AHU01 Frost
MV02	65	4.3	3	AHU01 Chilled Water
MV03	40	1.1	3	AHU01 Reheat
MV04	40	1.19	3	AHU02 Frost
MV05	50	1.9	3	AHU02 Reheat

All motorised valves to be supplied by controls specialist.

PART E – Workmanship and Materials

E1 General

E1.1 General Requirements

This section of the specification is general in nature and defines the type and quality of materials to be used, and working procedures to be adopted, which are common to the majority of mechanical services installations. Descriptions of materials and workmanship do not necessarily mean they are included in the Works. Any apparent conflict between this standard section and Section M3, the Particular Specification, or the tender drawings, shall be brought to the attention of the Engineer.

By virtue of submitting a tender for the Works, the Contractor is deemed to be competent in undertaking the type of Works covered by the tender documents. The Contractor shall employ materials and workmanship at least equal, or superior, to the standards laid down in the Specification. The Contractor shall inform the Engineer if any part of the works are not covered by the Specification, or Statutory Requirements, and seek his advice in respect of type and quality. The Contractor shall carry out all works necessary, whether detailed or not, in the spirit of the Specification.

E1.2 Statutory Requirements

The installation(s) shall comply with all relevant statutory requirements and regulations and in particular with the following:

BS7671:2008, IET Wiring Regulations, Seventeenth Edition, together with accompanying Guidance Notes.

Regulations under the Factories Act, Shops, Offices and Railway Premises Act.

Regulations under the Electricity at Work Act and the Gas Safety Regulations.

The Health and Safety at Work Act 1974 and the CDM Regulations.

The Clean Air Act and the Control of Pollution Act.

Any special regulations issued by the Local Electricity, Gas or Water undertakings.

The Building Regulations.

The CIBSE Guides and Technical Memoranda.

The requirements of the local Fire Prevention Officer.

British Standards Specifications and Codes of Practice.

The Water Supply (Water Fittings) Regulations 1999 and BS 6700.

The Control of Substances Hazardous to Health (COSHH) Regulations.

The Pressure Systems and Transportable Gas Containers Regulations.

Tenders shall be in compliance with the latest edition of any relevant regulation at date of tender. Any subsequent change to any relevant regulation throughout the course of the works shall be brought to the attention of the Engineer.

E2 Pipelines and Fittings

E2.1 Chilled Water Pipework

E2.1.1 Application

Chilled Water joints in pipework up to 50 mm conveying chilled water at up to 5 bar gauge.

E2.1.2 Pipe: ABS

Pre-insulated Cool Fit ABS Plus pipework, fittings and supports as manufactured by George Fischer.

E2.1.3 Pipe: Fittings

Pre-insulated Cool Fit ABS Plus pipework, fittings and supports as manufactured by George Fischer.

E2.2 LTHW Pipework

D2.2.1 Application

LTHW pipework, max temp 85°C

E2.2.2 Pipe: Mild Steel Heavy Quality.

Mild steel heavy quality BS EN10255, screwed ends to BS EN 10266-1:2004 taper, black varnished finish.

E2.2.3 Pipe: Fittings.

Fittings Malleable cast iron to BS 143 & BS 1256 or BS EN 10242. Finish - Black. Jointing: Threaded to BS 21 and BS EN 10226-1.

Use PTFE tape to BS 7786.

E2.3 Pipeline Supports

Pipeline supports shall comply with BS 3974 and shall take into account the size of the pipelines, their contents and materials of construction, the thermal and acoustic insulation, the vibration isolation components, the amount and direction of movement, the location of the pipeline in relation to the fabric and other services and the need for access. Components shall be correctly selected and adequately sized for their purpose.

Pipelines which are subject to thermal movement shall be carried on rollers or by supports incorporating a spherical pivot at its upper end.

Where a common pipe hanger is used, provision shall be made for unequal expansion.

Pipelines which are not subject to thermal movement may have their supports attached directly to the building fabric.

Where several pipelines run parallel to each other, each pipeline shall be individually fixed to a primary support system, consisting of gang-hangers. Each shall have at least two firm connections to the building fabric, one close to each end. Gang-hangers shall be spaced at the support interval appropriate for the smallest pipeline.

Supports for pipes in ducts and trenches shall be so spaced as to allow access to any pipes without disturbing the remainder and shall be set out so that they do not obstruct the access to valves, flanges or other fittings requiring maintenance.

In all cases of multiple supports, where pipes of differing sizes are supported from a common point attached to the building structure, such common points shall be spaced at the intervals required for the smallest pipe concerned.

Pipeline supports shall be located close to valves, bends and tee joints. Vertical risers shall be properly supported at the base. No reliance shall be placed on branches as pipeline supports. On pipelines over 100/108mm size, valves or groups of valves shall be supported at both ends. Pipeline sleeves and pipeline guides will not be regarded as pipeline supports. Pipeline supports shall not be attached to any plant or terminal units.

Hanger supports to drainage pipelines shall incorporate a turn buckle in the sling rod, or a suitable alternative to allow fine adjustment to be made to the pipeline gradient. Turn buckles shall be located at the top by a nut.

Pipeline supports for proprietary pipeline systems shall be spaced at not more than the support intervals recommended by the system manufacturer.

Additional supports shall be fitted at changes of directions, branch connections and connections to equipment as necessary.

Push fit 'U' shape plastic pipe clips shall not be used for any service under any condition.

Schedule of Support Spacings

Mild steel, copper and plastic pipelines

Pipe Size/Material		Horizontal (metres)			Vertical (metres)		
Steel	Copper Plastic	Steel	Copper	Plastic	Steel	Copper	Plastic
15	15	1.8	1.2	0.5	2.4	1.8	1.0
20	22	2.1	1.5	0.5	3.0	2.4	1.0
25	28	2.4	1.5	0.5	3.0	2.4	1.0
32	35	2.4	1.8	0.5	3.0	3.0	1.2
40	42	2.8	1.8	0.5	3.6	3.0	1.2
50	54	3.0	1.8	0.6	3.6	3.0	1.2
65	67	3.4	2.5	0.9	4.2	3.6	1.8
80	76	3.4	2.5	0.9	4.2	3.6	1.8
100	105	3.4	2.5	1.2	4.2	3.6	1.8
125	133	4.0	3.0	1.2	4.6	3.6	1.8
150	above	4.3	3.0	1.2	4.6	3.6	1.8

E2.4 Schedule of Pipeline Materials

Service	Nominal Size	Pipework	Fittings
LTHW Primary Circuit	15-50mm	Welded or screwed. Black Carbon Steel BS EN10255:2004, heavy grade (Table 5/red band), screwed ends BS EN10266:2004 taper, black varnished finish.	Malleable cast iron, reinforced pattern to BS 143 & 1256, screwed ends BS EN10266:2004 taper, self-colour with protective oil or varnish finish.
LTHW Secondary Circuit	54 -108	Copper to BS EN1057	Press fittings to BS 8537:2010 from 12mm to 108mm.
Chilled water	15-76mm	Pre-insulated Cool Fit ABS Plus pipework, fittings and supports as manufactured by Georg Fischer	Pre-insulated Cool Fit ABS Plus pipework, fittings and supports as manufactured by Georg Fischer

E2.5 Pipeline Supports

Pipeline supports shall comply with BS 3974 and shall take into account the size of the pipelines, their contents and materials of construction, the thermal and acoustic insulation, the vibration isolation components, the amount and direction of movement, the location of the pipeline in relation to the fabric and other services and the need for access. Components shall be correctly selected and adequately sized for their purpose.

Pipelines which are subject to thermal movement shall be carried on rollers or by supports incorporating a spherical pivot at its upper end.

Where a common pipe hanger is used, provision shall be made for unequal expansion.

Pipelines which are not subject to thermal movement may have their supports attached directly to the building fabric.

Where several pipelines run parallel to each other, each pipeline shall be individually fixed to a primary support system, consisting of gang-hangers. Each shall have at least two firm connections to the building fabric, one close to each end. Gang-hangers shall be spaced at the support interval appropriate for the smallest pipeline.

Supports for pipes in ducts and trenches shall be so spaced as to allow access to any pipes without disturbing the remainder and shall be set out so that they do not obstruct the access to valves, flanges or other fittings requiring maintenance.

In all cases of multiple supports, where pipes of differing sizes are supported from a common point attached to the building structure, such common points shall be spaced at the intervals required for the smallest pipe concerned.

Pipeline supports shall be located close to valves, bends and tee joints. Vertical risers shall be properly supported at the base. No reliance shall be placed on branches as pipeline supports. On pipelines over 100/108mm size, valves or groups of valves shall be supported at both ends. Pipeline sleeves and pipeline guides will not be regarded as pipeline supports. Pipeline supports shall not be attached to any plant or terminal units.

Hanger supports to drainage pipelines shall incorporate a turn buckle in the sling rod, or a suitable alternative to allow fine adjustment to be made to the pipeline gradient. Turn buckles shall be located at the top by a nut.

Pipeline supports for proprietary pipeline systems shall be spaced at not more than the support intervals recommended by the system manufacturer.

Additional supports shall be fitted at changes of directions, branch connections and connections to equipment as necessary.

Push fit 'U' shape plastic pipe clips shall not be used for any service under any condition.

E2.5. 1 Schedule of Support Spacings

Mild steel, copper and plastic pipelines

Pipe Size/Material		Horizontal (metres)			Vertical (metres)		
Steel	Copper Plastic	Steel	Copper	Plastic	Steel	Copper	Plastic
15	15	1.8	1.2	0.5	2.4	1.8	1.0
20	22	2.1	1.5	0.5	3.0	2.4	1.0
25	28	2.4	1.5	0.5	3.0	2.4	1.0
32	35	2.4	1.8	0.5	3.0	3.0	1.2
40	42	2.8	1.8	0.5	3.6	3.0	1.2
50	54	3.0	1.8	0.6	3.6	3.0	1.2
65	67	3.4	2.5	0.9	4.2	3.6	1.8
80	76	3.4	2.5	0.9	4.2	3.6	1.8
100	105	3.4	2.5	1.2	4.2	3.6	1.8
125	133	4.0	3.0	1.2	4.6	3.6	1.8
150	above	4.3	3.0	1.2	4.6	3.6	1.8

Refrigeration Pipelines

Material	Pipe Size	Horizontal (metres)	Vertical (metres)
Fully Annealed (Soft drawn)	3/16	0.8	1.0
	1/4	0.8	1.0
	3/8	1.0	1.2
	1/2	1.2	1.5
	5/8	1.2	1.8
	3/4	1.5	1.8
	7/8	1.8	1.8
Half Hard	1/2	1.2	1.5
	5/8	1.2	1.5
	1 1/8	1.5	1.8
	1 3/8	1.5	1.8
	1 5/8	1.8	2.4
	2 1/8	2.0	2.4
	2 5/8	2.0	2.4

E2.6 Pipeline Jointing

Steel Pipework, Screwed Joints

Threads cut on site shall be equal in quality to factory-made and shall be carefully reamed out before the plain end is screwed. Metal laid bare by the site screwing process shall have one substantial coat of primer applied.

Joints up to and including 32mm shall be made with PTFE tape, pipework of 40mm and 50mm shall be jointed with PTFE tape or hemp with prior approval of the Engineer. Hemps shall not be used for pipelines for domestic water, steam or natural gas. Defective joints must not be caulked.

Steel Pipework, Welded Joints

BS 2640 for oxy-acetylene
Class 11

BS 2971 for electric arc welding
Class 11

Welding shall only be carried out by certificated welders holding a current certificate of competence from an approved body. The Contractor will be required to produce evidence that each welder holds a current approved certificate.

All pipework and fittings shall be correctly prepared and set up prior to welding. Pipe ends shall be cut square, deburred and bevelled. The number of welding passes shall be as required for the pressure to which the pipe will be subjected. Branch fittings, shoes etc., shall be of the swept pattern, installed to suit the pipe contents flow. Branch apertures cut into the main shall be deburred and bevelled. Neither the branch fittings, nor the weld, shall reduce the specified main or branch bore diameter.

All welds shall fuse fully with the parent metal, be free from slag and scale and of thickness never less than the parent metal. Welding rods shall be clean and dry. Arc welding rods shall not be used if the coating is damaged or decomposing. The type of welding rod shall be that which the manufacturers recommend for the class and type of welding.

The Contractor shall allow for up to 2% of all welds to be cut out for test purposes. If tests prove unsatisfactory the Contractor shall cut out further welds for test as directed by the Engineer.

Steel Pipework, Flanged Joints

Flanges for steel pipework shall be of forged steel having machined raised faces to BS 4504.

Joints shall be made up using asbestos free composite full-face Klingerite type or corrugated brass "Taylors type" joint rings, graphite-faced both sides, and hex-headed steel bolts, nuts and washers to comply with the requirements of BS 4504 for the temperature/pressure conditions scheduled. When fully tightened, bolt shanks shall not extend beyond the face of the nut by more than 5mm. Only normal length spanners shall be used. Bolts used to effect cold-draw shall be removed after pulling up is complete and replaced with bolts of normal length.

Flanges with distorted faces shall be replaced before making flanged joints. Flanged mating flanges shall be square to the axis of the pipeline. Flange bolt holes shall be aligned on the pipeline with four hole at 45 degrees to the horizontal and vertical axis and six hole on the horizontal axis. The only variance to this practice that will be permitted is when mating to fixed equipment.

Up to 100mm pipework flanges may be of the screwed or welded type. Above 100mm on black mild steel pipework shall be welded.

Screw-on type flanges are preferred on galvanised mild steel pipework only up to 100mm but may be used up to 150mm at the discretion of the Engineer. Welded flanges may not be used directly onto galvanised pipework. Where required the item shall be prefabricated and galvanised after manufacture.

All flanges shall be manufactured from mild steel to BS 4504 to the table appropriate for the temperature and pressure specified. Flanges shall incorporate bolt holes drilled not punched and shall be black or galvanised to suit the pipework upon which they are to be installed.

For screwed flanges the threads on the tube shall end just inside the back or boss of the flange. After fitting, the tube shall be expanded into the flange by a roller expander.

Slip on welding flanges shall be secured by welding both the neck and the bore of the flange to the pipe, with the tube finishing 3mm inside the bore. Care shall be taken not to distort the machined face.

E2.7 Installation

General

Pipework installations shall be demountable in manageable sections to facilitate routine maintenance, alteration or expansion by the use of unions or flanged joints.

All pipework shall be run in a neat and tidy manner with vertical pipes plumb and horizontal pipes level. Where laid to a rise or fall, a constant slope shall be maintained. Multiple pipes run together shall be parallel in both horizontal and vertical planes (except where purposely laid to fall). Purpose sized fittings shall be used for connection from mains to branch. If a reducing tee is not available a mains sized equal tee shall be used with the appropriate concentric or eccentric reducer. Multiple flanged pipe runs shall have their flanged joints staggered a minimum of 250mm apart on adjacent pipes. All springs or sets shall be cold or fire drawn, formed on long lengths of tube with as long a radius as practicable and of true formation with bore free of buckles and kinks.

Before installation all pipework shall be inspected to check that bores are free of obstruction. All burrs, rust, scale and other defects shall be removed. Lengths of ferrous tube shall be held vertically and rapped with a hammer to remove loose scale. Open ends of installed pipework, when left unattended, shall be blanked off with metal or plastic plugs, caps or blank counter flanges. Wood or paper plugs will not be allowed. Heat and corrosion resistant paint shall be applied to pipework and welds immediately after erection to avoid corrosion.

Insulated adjacent pipes shall be installed to allow each pipe to be insulated separately with a minimum 25mm clear of all other surfaces. Uninsulated pipes shall be separated by a minimum 50mm clear of all other surfaces.

Joints shall not be made in the thickness of any wall, floor or ceiling. Pipework shall not be embedded in any brickwork, concrete, plaster or screed depth. Where pipework passes through walls, floors or ceilings, tubular pipe sleeves of a similar material shall be fitted. Where exposed to view proprietary collars shall be fitted. Inaccessible pipework shall be welded or brazed.

Where pipes pass through 'tanked' or reinforced concrete walls, suitable puddle flanged pipes or puddle flanged sleeve pipes shall be installed to prevent the ingress of water. Underground pipework shall be wrapped with Densotape as manufacturer's instructions.

Connection between piping of dissimilar materials and between piping and equipment of dissimilar materials, shall be avoided and made only after consultation with the local Water Supply Undertaking, in a manner approved by them.

The Contractor shall, using manufactured fittings, bend all pipes round piers and all other projections and recesses and for all offsets due to varying thicknesses of plaster, walls, ceilings, beams and other structural works whether such changes in direction of piping are indicated on the drawings or not. It shall be the responsibility of the Contractor to ascertain the skirting and ceiling heights, sill heights and finished floor levels.

Bends formed in steel pipelines up to 50mm size may be bent cold using a machine with clean unmarked formers and guides. Above 50mm size tubes shall be bent hot, loading the tube with

inert granular material. Bends shall be normalised by heat treatment after forming. The tube shall retain its roundness throughout the length of the tube. Avoid thinning and corrugating of the tube wall. The finished bend shall be capable of attaining the scheduled performance of the pipelines.

Bends formed in copper pipelines shall be made on a purpose-built machine of the draw-bar or mandrel type which can produce perfect bends without any restriction of bore. No pulled bends with any deformity in the forming of the bend will be accepted and the Contractor shall replace, at his own expense, any which do not meet this standard. Compression type bending machines which produce a restriction in bore shall not be used.

The Contractor shall obtain and use the correct tools for the assembly of pipeline systems and these shall be carefully maintained to keep them in good condition. Only normal length spanners shall be used and torque wrenches shall be used where recommended by the manufacturer of the component or the system. Avoid tool marks or damage on the components of a pipeline system. Where this does occur, repairs shall be made or, in the case of damaged spanner flats or screwdriver slots, the component shall be replaced. Damaged tools shall be removed from the works.

Tubes shall be cut clean and square with the axis using a saw or tube-cutting tool or machine. Tubes shall not be flame cut. The end of the tube shall be correctly prepared for jointing. The bore shall be reamed out to remove burrs and swarf. Where tubes are held in vices, ensure that the outer surface remains undamaged. Tool marks shall be filed away, the tube left smooth and protective coatings made good with primer.

Grading, Venting and Draining

Pipelines shall be installed to facilitate draining and release of air.

Horizontal pipelines shall be graded as follows:

Pipelines carrying liquids by gravity flow: or as drawn	1.66%
Pipelines carrying liquids under pressure:	0.40%
Pipelines carrying gases under pressure:	Level

Drainage points shall be installed at the following locations:

- Accessible low points on the pipelines
- Low points on heat transfer coil connections
- Low points on all plant and equipment containing water
- On the branch side of branch isolating valves.

Drain points shall be positioned as unobtrusively as possible. If a drain cock is positioned where it may prove a danger or a nuisance, an elbow shall be fitted so that the drain cock lies parallel to the pipe drained and is protected by it. Air bottles/vents shall be located at all high points in the system.

Discharge pipelines from air bottles, automatic air eliminators and safety valves shall be taken to a suitable point and grouped together where convenient. Air bottles, automatic air eliminators and discharge pipelines shall be protected from freezing.

Drain cocks shall be complete with a proprietary hose union connection. Where specified, a permanent drain pipe shall be fitted and arranged to discharge over a prepared drain point. Where the function of the drain is to continually bleed to waste, a regulating valve and sight glass or tundish arrangement shall be fitted after the drain cock, in the drain pipe run.

For pipe sizes up to and including 50mm diameter, a 12mm drain cock with hose union and/or piping shall be installed. For 65mm diameter and above, a 20mm drain cock with hose union and/or piping shall be used.

Thermal Movement

Thermal movement in pipelines shall be proportioned about the system by the provision of anchors at suitable points. Provision for thermal movement shall be generally made by changes in direction of the pipeline. Where natural changes of direction prove inadequate, provision shall be made by the use of formed expansion loops, expansion bellows, guides, anchors, cold draw, floating hangers as necessary.

Expansion bellows or compensators shall be used for the control of larger amounts of movement than can be controlled by cold draw. Stainless steel bellows shall be used on steel pipework, stainless steel or phosphor bronze on copper pipework. Care shall be taken to avoid twisting the convolutions whilst making the bellows to pipework joints. The bellows shall compensate for movement in the axial pipe plane only.

Where expansion loops are required ensure that the 'cold draw' is provided in the associated pipe runs. The jointing of the loops shall not proceed until the Contractor has shown to the satisfaction of the Engineer that restraint has been correctly applied and that the runs are guided to provide for true axial movement.

Branch connections from mains shall allow the thermal movement of the main without putting strain on the branch. Where this cannot be achieved, the pipeline shall be anchored in suitable places and a purpose-made expansion bellows shall be inserted in the pipeline between anchors.

A pipeline guide shall be fitted within two pipe diameters of the moving end of an expansion unit, with a second guide a further 15 to 20 pipe diameters distant from the first. Guides shall permit movement along the axis of the pipe only.

Friction type guides shall consist of a purpose made moving component securely affixed to the pipe and a purpose made bearing/guiding component securely affixed to the building structure. The rubbing surfaces shall be lubricated or faced with proprietary materials, suitable for the pipe surface temperature, such that a low co-efficient of friction is maintained for the life of the installation.

Pipe anchors shall be securely fitted to both pipe and structure. They shall be constructed to accommodate twice the calculated pull or thrust. Floating pipe hangers shall employ brass hemispherical washers or nuts together with locking locknuts. The pipe clip may thus swivel relative to the drop rod. The locknut shall prevent the assembly working loose. Welded joints shall not be made within 600mm of an anchor point.

E2.8 Valves And Cocks

General

Valves etc., shall be screwed to BS21 for sizes up to and including 50mm. For 65mm diameter and above they shall be flanged.

The Contractor shall supply and install valves, taps, strainers and cocks in the positions specified and wherever necessary to meet the operational and maintenance requirements of the system, to afford the proper working, isolation and regulation of the system and shall be suitable for the system working and testing pressures.

All three port control valves shall have the variation in inlet or outlet port pressure equalised as necessary by the use of single or double regulating valves, such that the flow control function of the valve is unaffected by port pressure imbalance.

On chilled water and heating systems, isolating valves shall be installed in the flows and flow measurement fixed orifice double regulating valves (i.e. a double regulating valve close coupled to a flow measurement device-commissioning station) in the returns from all mains, circuits, sub-circuits and connections to coils, other items of plant and elsewhere where indicated on the drawings.

On domestic hot water services isolating valves shall be provided in the flows to and regulating valves in the returns from all mains, circuits and sub-circuits. Isolating valves or stop cocks as appropriate shall be fitted to all deadlegs.

Lubricated plug or diaphragm valves may be used on main gas pipelines. Plug type gas cocks and valves shall be used at all plant connections for positive shut off. The Contractor will be responsible for ensuring that the type of valve used meets the requirements of the local Gas Authority.

Three way vent cocks shall be installed on installations with multiple boilers and calorifiers. The cocks' vent outlet shall be connected to a common vent pipeline.

Stopcocks or quarter turn ball type valves shall be fitted at all draw off points on hot, cold and drinking water services.

All gaskets, fire seals and packing shall be asbestos free and shall be suitable for potable water systems.

All valves on domestic hot and cold water systems shall have body parts in contact with the water resistant to dezincification.

If required by the local Water Board, the Contractor shall include for individually testing and stamping of valves, stopcocks etc.

Commissioning Stations

The commissioning stations specified hereinafter and/or shown on the drawings are flow measurement devices, close coupled to the double regulating valve on the return (i.e. single valve commissioning). In positioning commissioning stations fully comply with the manufacturers recommendations.

Where, as an alternative, commissioning stations of the remote type are selected, include for all necessary works associated with their required location and compliance with the manufacturers recommendations (i.e. two valve commissioning).

Double regulating valves forming part of the flow measurement devices shall be selected for particular application such that the flow rates are achieved with the valve position more than 25% open.

In order to minimise spurious turbulence in the flow thorough flow measurement devices such as:

Orifice plates or rings

Flow measurement valves

Flow measurement fixed orifice double regulating valves

Flow measurement variable orifice double regulating valves

The device shall be fitted with a minimum of 10 diameters of straight pipe; of the same nominal bore upstream and at least 5 diameters of straight pipe downstream clear of any disturbing influences such as bends, tees, valves, vessels, etc.

Isolating Valves

Gate Valves

Wedge or double disc cast iron valves shall comply with BS5150 and BS5163 (for waterworks purposes). Cast steel valves shall comply with BS1414 Class 300. Bronze valves shall comply with BS5154.

Butterfly Valves

Shall comply with BS EN 593 and may be lever or hand-wheel operated, but shall have open/shut indication with a locking facility to retain the valve in the selected position. The valves shall be clearly marked and be suitable for the service ratings.

Diaphragm Valves

Diaphragm valves shall comply with BS5156 with the diaphragm material selected to suit the specified pipeline function and with clear indication of material type.

Lubricated Parallel Plug Valves

Shall comply with BS5353 and BS5158. Each valve shall be complete with a loose key or wrench of mild steel, forged to shape. The valves shall be parallel plugs and be arranged for 90° operation with stops on the valve body to limit movement. A ball valve check shall be incorporated in the plug for the retention of lubricant applied under pressure. Valves of 125mm and above shall be arranged for geared operation.

Parallel Slide Valves

The valve shall give full through-way bore when in the open position, with a sliding action 'disc on seat' arrangement. The valve shall incorporate a rising spindle with a cross bar, which limits the travel in the closing direction.

For sizes of 15 to 50mm the valve shall be bronze and comply with BS5154 and either screwed to BSPT or flanged. For sizes of 65mm and above the valve shall be cast iron flanged and comply with BS5151. All valves of 200mm diameter and above shall be drilled for welded by-pass connections. All valves shall have drain tappings.

Regulating Valves

Regulating valves shall be employed in the balance of all distribution circuits such that the required energy flow is presented to the plant in question. Regulating valves shall be set to provide the design flow rate and locked in that position. Where combined isolating and regulating valves are used, they shall be fully repeatable in their calibration, as well as complying with the temperature and pressure requirements of the system. All regulating valves i.e. single and globe valves shall comply with BS5154.

Valve Identification

All valves within plant and boiler rooms, and all circuit control valves, shall be clearly identified with a reference number. The numbers shall be marked on purpose drawn circuit diagrams inserted in the operating manual. A non-fading copy of the circuit diagram shall be mounted in a glazed hardwood frame permanently fixed to the plantroom wall.

Engraved labels shall be affixed to the valve body using brass chain. Labels shall not be affixed to the hand-wheel of the valve. Where the piping is insulated and a valve box conceals the valve, the label shall be hung on the insulated pipe adjacent to the valve.

E3 Pipelines and Fittings Above Ground Drainage

The Specification shall be adhered to in the fabrication, installation and testing of all systems. Any deviation from the materials specified will only be permitted if written approval is given by the Engineer prior to commencement of work.

E.3.1 Pipework and fittings

All pipework, fittings and accessories shall be identified by the appropriate British Standard Kitemark symbol.

All pipework shall be provided in the manufacturer's standard lengths. Pipework and fittings shall be properly stored and protected on site, in accordance with the manufacturer's recommendations.

All pipes and pipe fittings shall be carefully examined before fixing and any which are defective shall be rejected.

Jointing rings, couplings and adapters shall be of types recommended by the manufacturer of the pipes being jointed. Rubber joint rings shall be stored in their delivery bags and not exposed to sunlight.

The Contractor shall make allowance within his works for all transitional fittings to enable the connection of the above ground drainage to the below ground systems.

All other pipework materials shall be as indicated on the Tender Drawings.

E.3.2 Pipework Installation

All pipes shall have the internal burrs removed after cutting.

Particular care shall be taken that all pipework is erected and secured truly parallel and plumb with vertical surfaces.

All horizontal waste and soil pipework shall be arranged with a minimum fall, or rise in the case of branch ventilating pipework, from traps of 1.25°.

Joints shall not be made in the thickness of any wall, floor or ceiling and pipework shall not be embedded in brickwork or concrete unless specially ordered.

Access caps or plates shall be fitted at the end of all above-ground drainage horizontal pipework, at junctions and changes of direction. Access plates shall be fitted at each floor level immediately above the highest connection, at the foot of each vertical stack and at junctions to horizontal connections to enable the complete disposal system to be internally cleaned and rodded.

Main branch above ground drainage ventilating pipes, if required, shall be run above spill-over level of fittings except where shown, and if connected to main soil, soil waste or waste pipes, the connection shall be at a point above spill-over level of the highest sanitary appliance connected to such pipe.

At the roof penetration positions, a suitable method of providing a water seal and weathering shall be used. Soil and waste vent pipes shall terminate to atmosphere with wire bird cage. Free area for ventilation purposes shall be retained.

Where cutting of cast iron pipework exposes ends, pipework should be primed and painted to prevent corrosion.

E.3.3 Expansion and Contraction

Long runs of pipework shall be erected so that stresses of expansion and contractions due to temperature variation are taken up by expansion joints. Where small bore branches are made to mains remote from anchor points, the branches shall be arranged to form a radius arm so that the axial movement of the main does not stress the connecting fittings.

Where expansion devices are used, they shall be of similar material to the pipe, installed in line with the axis of the pipe and shall be free from compression, tension and torsion. The female member of the expansion device shall be firmly anchored to allow the male member to make all the movement.

E.3.4 Sleeves

Where pipework passes through walls, floors or ceilings, tubular pipe sleeves of a non-combustible material compatible with the pipework shall be fitted. The internal diameter of the sleeve shall, except where necessary to allow for expansion and contraction, or where otherwise specified, not exceed the outside diameter of the pipework enclosed by more than 30mm and shall project 3mm beyond the finished surfaces.

Sleeves in a vertical position where washing down of floors, etc, is likely to be carried out, shall project 40mm above the finished floor level.

Where pipes pass through a fire barrier, they shall be provided with an approved fire stop complying with the Fire Officer's requirements. The unit shall provide the same thickness of insulation as used on the pipework either side of the barrier where the pipes are insulated. The insulation and any vapour barrier shall be continuous. For bare pipework, the fire stop shall have sufficient thickness of insulation to accommodate movement due to expansion.

All sleeves, puddle flanges and patented fire stops shall be built into the structure by the Contractor in such a manner as to maintain the integrity of the structure and the fire barrier.

E.3.5 Fire protection of pipework

Where pipes penetrate through fire compartments, proprietary fire collars must be built in. These should be provided for pipework of dimensions 50mm and above and collars should be in accordance with BS 476 and Building Regulations part B.

Collars should have a 2 hour rating. All Fire collars to hold an independent test certificate.

E.3.6 Ducts and Access for Pipework

All pipework enclosures, ducts and casings shall provide ready access for maintenance, testing and cleaning.

All pipework access for cleaning shall be carefully sited to allow the entry of cleaning apparatus, and consideration shall be given to other services accommodated in the duct.

The layout of services in vertical ducts shall be as shown on the drawings

E.3.7 Testing

E.3.7.1 General

The Contractor shall provide clean water and all assistance and appliances necessary for testing to the Local Authority and Engineer's approval.

The Contractor shall ensure that all sections of the above ground drainage systems are clear of any obstructions, debris, etc, before tests are applied and also upon completion of the Contract.

The Contractor shall locate all defects revealed by the tests, shall remedy them and re-test until a satisfactory result is obtained.

The Contractor shall notify the Local Authority representative and Water Company regarding commencement of the testing work and shall arrange for all inspections and final test witnessing required by them.

Should leaks develop in any part of the system after being set in operation, it shall be the responsibility of the Contractor to repair the leaks. If damage to the building structure or any item of contents has occurred as a result of such leakage, rectification of the damage will be the responsibility of the Contractor.

E4 Identification And Finishes

E4.1 General

All services shall be identified to indicate the nature of the service and direction of flow, except pipework buried below ground in direct contact with earth. In this case, a continuous red tracer tape 100mm wide, in non-degradable plastic shall be laid 200-250mm above the pipe during the refilling process.

E4.2 Pipework and Ductwork

All services (pipework and ductwork) irrespective of whether insulated or not in plant spaces, tank rooms, roof spaces, false ceilings and ducts etc. shall be provided with colour coded identification bands and labels to B.S. 1710 for pipework and HVCA DW/144 for ductwork indicating service, size and direction of flow.

The identification bands and labels, on suitable ground colours, shall be applied either by painting, or by PVC tapes. Where colour coding is painted on, it must be carried out using heat-proof paint. If not self-adhesive fit the PVC tape using double sided adhesive tape.

The identification bands and labels shall be fixed at all junctions, at both sides of service appliances, bulkheads, wall penetrations, service duct openings and at intervals of 12 metres maximum plus any other places where identification is considered necessary.

The identification of all exposed services external to buildings shall be painted on; PVC tapes will not be accepted.

E5 Ductwork And Fittings

E5.1 General

The ductwork shall be constructed and installed to the standards and permissible methods defined in the following detail clauses, for the specified pressure duty and the specified leakage rates.

Fabrication and installation shall be carried out in a neat and workmanlike manner. No rough edges, shear marks, distortion, bowing, buckling, or denting, will be accepted. Ductwork shall be kept clean, both internally and externally, during manufacture, delivery and installation. Severe corrosion shall mean the total replacement of the corroded section. Minor corrosion shall be removed or stopped immediately during the installation process. The Engineer's decision on quality is final.

E5.2 Galvanised Ductwork

All ductwork shall be fabricated from hot dip galvanised sheet or coil to BS EN 10143. The coating shall withstand the manipulation and forming required during the manufacturing process without any separation of the protective zinc coating from the parent metal.

E5.3 Rectangular and Circular Ductwork

Ductwork shall be constructed and installed in accordance with the HVCA DW 144, high and low velocity ductwork specification. A schedule of methods of jointing and sealing shall be submitted for approval before installation commences. Air leakage shall be kept to a minimum.

On bends and offsets, the centre line radius shall be equal to 1.5 times the duct width. Where long radius bends are not possible, turning vanes or splitters shall be fitted. Square bends and splitters may be used for sound attenuation purposes. On circular ductwork, spiral conduits shall be used with standard factory made fittings. Setting out of ductwork shall minimise the number of changes of direction or shape to avoid increasing resistance, creating localised high velocity or excessive turbulence. Connections to grilles or diffusers shall be in accordance with the manufacturer's recommendations regarding air approach, neck length, equalising control and volume control. Flexible ducting shall be non-combustible and accepted by the Fire and Local Authorities and shall be used only where specifically approved and limited to 1000mm max length when extended to minimise pressure drop and noise.

If required, hand holes shall be cut to allow internal fixing or sealing of joints. Hand holes shall be trimmed smooth and the covers coated with sealer to provide internal filler to edges otherwise exposed to air stream. The covers shall be riveted on and the rivets sealed.

Flanges and supports, not otherwise protected, shall be thoroughly wire brushed and cleaned to remove scale, rust, grease, dirt and other foreign matter and painted with one coat of red oxide paint immediately after fabrication.

Ductwork and plant connections shall be fabricated and erected with particular emphasis on air-tightness, avoidance of noise generation and to minimise frictional resistance and turbulence. Ductwork and equipment jointing flanges shall correspond with corners neatly finished

Access panels shall be provided for Fire/Fire/Smoke damper fusible linkages and volume control dampers where the larger side is 400mm or more. In branch ducts off the main risers, inspection openings for dampers not smaller than 100mm square shall have air tight covers. Access panels shall be provided for internal cleaning at 10 metre intervals or 5 metres for kitchen extract systems.

E5.4 Flexible Ductwork Connections

Flexible connections shall be fitted to each fan intake and discharge, and to plant containing vibration generating equipment, they shall be made from a material to the Fire Officer's approval which is non-combustible and rot proof and of a quality and grade to suit the temperatures, velocities and pressures involved.

Flexible connections shall be fitted free from stress and shall not support any weight on rectangular sections. The material shall be securely fixed to a frame and not secured by straps.

E5.5 Volume Control

Dampers for volume control at diffusers and registers shall be in accordance with manufacturers' recommendations. Additional dampers shall be fitted in each terminal branch connection where excessive noise could be generated by reliance on the terminal damper.

System control dampers shall be fitted to enable the system to be effectively balanced and regulated. These shall be opposed multi-blade streamlined blade pattern arranged to provide a variable venturi opening. The volume control dampers shall be proprietary manufactured units. Manual adjustment or operation shall be from outside the duct and a suitable locking device fitted. The final setting position shall be permanently fitted. Motorised control dampers shall be fitted with suitable linkages for electric motors.

Dampers shall be constructed in a separate duct section suitably stiffened. Blade spindles and bearings shall be of corrosion resistant material and arranged to avoid leakage. Lubrication to all dampers shall be provided at the time of installation and the mechanism operated to ensure free movement prior to installation. Dampers shall be left in a fully open position with quadrant lever correctly indicating its position.

E5.6 Fire/Fire/Smoke dampers

Wherever ducts pass through fire walls, ceilings or floors or wherever required or recommended by the Fire Officer, Fire/Fire/Smoke dampers with installation frames shall be fitted. These shall be constructed to the Fire Officer's or Local Authority requirements and shall be fusible link operated or magnetic on smoke or heat detection. Fire/Fire/Smoke dampers shall have stainless steel blades with 16 gauge galvanised frames and comply with BS 476.

E5.7 Test Points and Instruments

At points throughout the system of ductwork, test points, suitable for pitot tube insertion, shall be provided on two adjacent sides of ducts as determined by the access available and spaced according to BS 1042. They shall consist of 25mm dia. holes, fitted with a cover. Test points shall be positioned where air flow is stable and includes each branch duct as well as suitable locations in the main ducts. Total air handling unit performance and branch duct flow rates shall be obtained using a pitot tube and inclined gauge manometer or direct reading digital tester.

For measuring air quantities at grilles or diffusers the appropriate jets shall be used with a velometer and the manufacturer's measuring procedure followed, or by using an anemometer and a calibrated hood. These measurements shall be used for a proportional balance of the system only when the system volume has been determined.

E6 Water Treatment

E6.1 General

All hydraulic systems shall be totally cleaned, sterilized and, where not for human contact, fully inhibited against corrosion. Systems in contact with air shall have automatic provision for dosing, treatment and or bleed to drain such that no oxygen based corrosion, bacterial growth, sludge formation or methane generation can occur. All chemicals and inhibitors shall comply with the requirements of the Health and Safety at Work Act.

All water systems shall be designed and installed to the latest recommendations of the HSE Guidelines. The Contractor shall take all necessary precautions in the prevention of the growth of the Legionella bacteria.

To meet Building Control requirements all effluent must be discharged into a foul water drain. A permit for discharge of effluent may be required. Any effluent discharge to the foul drain must have a PH value of between 7 and 9.

Should the Water Authority not permit the opening of the Town main isolating valve until the incoming main and rising main have been sterilised (to avoid the possibility of contaminating the Town main), an adequate supply of water must be arranged from an independent service. The cost for such arrangement shall be included at the time of tender.

Following disinfection of the various systems, certificates shall be obtained from an independent NAMAS accredited laboratory, that water drawn from the systems after the treatment is free from bacterial contamination.

E6.2 Piped Systems

Flushing and treatment

On completion of the pipework and equipment installation, the system shall be filled with water and inspected for leakage. This is in addition to sectional pressure testing during the progress of the installation. After a 24 hour static test, which shall be continuously supervised where leakage could cause damage to the building finishes, the circulating pump shall be operated for one hour. During this period the pipeline strainers shall be installed in working position.

After the one hour circulation, the pipe system shall be totally drained of all water, the strainers dismantled, thoroughly cleaned and then reinstated.

The pipe system shall be refilled with clean water together with the necessary quantities of cleaning chemicals. The system pumps shall then be run continuously for 24 hours. If, during this time the differential pressure gauges across the pump/strainer, change reading, the strainer shall be re-cleaned.

After 24 hours running, the system shall be totally drained of all liquid.

The system shall be refilled, run for one hour and drained. This rinsing process shall be repeated until the water drained from the system is clear, free from discolouration and suspended solids.

Treatment of the systems shall be by the use of a multi-metal passivation chemical and to a level as recommended by the chemical manufacturer. Cleansing and inhibiting chemicals shall be of proprietary manufacture and used in accordance with the manufacturer's safety instructions.

Pipeline systems generally

Pipework circuits shall be provided with facilities to enable sections of pipework to be isolated and for circuits to be individually flushed. Circuits serving a number of terminal units e.g. radiators, fan coil units etc., shall be provided with valved loop returns at the ends of the circuits to clean pipework before flushing terminal units.

All "dead-legs" greater than 2 metres in length shall be cross-connected between flow and return terminations to ensure adequate circulation of water is maintained during the cleaning process. These connections shall be of a similar bore to the pipework.

All terminal units such as FCUs, AHUs etc., shall have a full bore bypass installed and provision made for backflushing to take place.

Where new systems are connected to existing systems the Contractor shall ensure that all new chemicals proposed are compatible with any existing chemicals present in the system.

Chemical Sterilisation

General

The Contractor shall keep the piped systems and equipment free from dirt, dust and organic matter, during installation. All water and gas systems shall be thoroughly cleaned and, after the cleaning process, sterilised in accordance with procedures described in BS EN806. This applies to all systems where regular human contact with the pipe contents is involved (i.e. hot water, cold water, oxygen etc.) All cisterns, tanks and calorifiers shall be similarly treated. Particular care shall be taken to replace all close fitting covers to storage tanks containing water for human use, after chemical sterilisation has been completed.

All chemicals shall be safe for use and normal handling to manufacturer's instructions. No solid or granular chemicals shall be introduced into the piped system. All chemicals shall be premixed in liquid form and gradually poured into the system leaving behind any undissolved solids.

New Piped Systems

Mains cold water, cold water down service, domestic hot water and external mains cold water.

All pipework, storage tanks, cisterns, calorifiers and domestic appliances shall be thoroughly cleaned of all construction dust and then disinfected. The disinfection shall be carried out by specialists, who shall submit signed certificates to warrant that the systems have been properly disinfected. All certificates shall be placed in the Operating and Maintenance manual prior to handover.

On completion of disinfection, the treated systems shall be thoroughly and totally flushed out twice with clean water before being handed over for use.

Sterilising Chemical

Sterilising chemicals shall be of proprietary manufacture and used in accordance with the manufacturer's safety instructions.

Sterilising chemicals shall be chlorine based and diluted at the point of injection to prevent the corrosion of copper or brass materials in the systems. Chemicals shall not be left in the system in excess of 16 hours.

E7 Testing And Commissioning

E7.1 General

The Contractor shall include for the complete testing and final commissioning of the installation to the satisfaction of the Engineer.

The Engineer shall be granted access at all reasonable times to the works for the purpose of inspecting, examining and testing of materials, workmanship and performance of the plant.

Unless specified otherwise, the Contractor shall provide all labour, materials, power, fuel and test equipment for carrying out the tests specified. Tests shall be on site and/or off site, as applicable to the test specified.

The Contractor shall give a minimum of seven working days' notice, in writing, for appropriate persons to attend inspections and witness tests or demonstrations at works or on site. Provide all necessary facilities and assistance for the employer's representative to attend inspections or witness tests, as required.

E7.2 Definitions

The definitions for works, phrases associated with the design, manufacture and site work for the mechanical and electrical installation shall be those of the IEE Regulations, the Institute of Plumbing Design Guide, CIBSE and BSRIA Guides, British Standards, Codes of Practice, associated Statutory Acts and Authorities.

The CIBSE and BSRIA Guides referred to are as follows:

- CIBSE Commissioning Code A: Air Distribution Systems
- CIBSE Commissioning Code B: Boiler Plant
- CIBSE Commissioning Code C: Automatic Controls
- CIBSE Commissioning Code M: Commissioning Management
- CIBSE Commissioning Code R: Refrigerating Systems
- CIBSE Commissioning Code W: Water Distribution Systems
- BSRIA Application Guide AG 2/89.3. Commissioning water systems in buildings
- BSRIA Application Guide AG 3/89.3. Commissioning air systems in buildings
- BSRIA Application Guide AG 1/91. Commissioning of VAV systems in buildings
- BSRIA Application Guide 1/01. Pre-commission cleaning of pipework systems.

The Contractor shall ensure that all systems are tested and commissioned to the latest editions of these publications and any supplementary publications.

The following definitions shall apply to the activities associated with testing and commissioning of the works.

Pre-Commissioning Checks - Pre-commissioning is the phase of work which takes into account the activities necessary to advance an installation from the static completion to the commissioning phase.

Commissioning - In accordance with the Commissioning Codes, commissioning is defined as the 'advancement of an installation from the static completion to full working order to specified requirements'. Commissioning includes the setting to work and regulation of an installation. Commissioning is deemed to be complete when all regulation work is concluded.

Performance Testing - Performance testing is the evaluation of a system which has been commissioned and is operating within the tolerances as set out in the Specification and the relevant commissioning Codes and Guides.

E7.3 Personnel

All commissioning shall be carried out by trained, experienced commissioning engineers. The supervising commissioning engineer shall have a minimum of five years' experience in commissioning and performance testing of mechanical, public health and sanitary, heating, ventilating and air conditioning system installations.

All commissioning and performance testing of major items of equipment including boilers, air handling plant, control panels and control systems shall be undertaken by the manufacturers' personnel.

E7.4 Instrumentation

The Contractor shall submit a list of the equipment proposed for use during commissioning and performance testing prior to commencement of commissioning and shall ensure that all instruments that require periodic calibration are recalibrated immediately prior to the beginning of measurement work on site. The Contractor shall provide all instrumentation necessary for the complete testing and commissioning of the works.

E7.5 Commissioning Sets

Select commissioning set sizes against the manufacturers recommendations for flow rate, flow velocity and signal pressure. Notwithstanding the manufacturers recommendations, the signal pressure generated by the commissioning set at the specified water flow rate shall in not be less than 1.0kPa, nor be higher than 4.5kPa. The pressure loss imposed on the system by the commissioning set (allowing for the combined effect of the orifice plate and the regulating valve) shall not exceed 8.0kPa. Where it is necessary to meet the above requirements, reduce or expand from the line size shown on the general arrangements drawing to the size of commissioning set selected. Include for all necessary fittings and pipe lengths necessary to accommodate this change of size. Install minimum straight upstream and downstream pipe lengths as recommended by the manufacturer at the size of the commissioning set selected.

The Contractor shall submit details of proposed commissioning sets if they are not identified in the Particular Specification or if he is proposing alternatives. Commissioning sets shall be installed in all positions commensurate with good practice and as recommended in the abovementioned Guides whether shown on the drawings or not.

E7.6 Environmental Checks

The Contractor shall carry out checks and adjustments to ensure the specified conditions of temperature, relative humidity and the air movement are achieved in each space.

The Contractor shall carry out sound level checks in each space using a simple dbA weighted meter. Where the sound level in any space exceeds the specification limits, repeat the test with an instrument capable of octave band analysis and present the results plotted against NR curves, together with a report giving the possible cause and suggest remedial action.

E7.7 Procedures**Work Stages**

Progress testing, final testing and commissioning shall be undertaken during the course of the Works generally as described in the following stages:

Stage 1: Works Prior to Commissioning Including Progress Testing

The Contractor shall carry out all necessary inspections and tests to ensure the quality and performance of the installations and record all such tests. Copies of test certificates shall be

retained on site during the Works and incorporated in the Record Documents. Where installations are to be insulated, pressure tests shall be carried out and witnessed prior to application of the insulation.

Stage 2: Final Testing

The Contractor shall invite the Engineer to witness all final pressure, vacuum and air leakage tests necessary to bring the complete installation work up to a standard of 'static' completion.

Subject to satisfactory testing, the Contractor shall provide for each test a clearance certificate which shall indicate the test carried out, the date of the test and the result.

Stage 3: Commissioning

Following satisfactory testing, the Contractor shall undertake the proving of the engineering systems from the 'static' completion state to a fully operational one.

The proving of the system shall include all the system balancing and recording of test data and points, together with the setting of the environmental conditions and recording test data against external conditions.

Stage 4: Performance Testing

Prior to handover of the completed works the Contractor shall invite the Engineer to witness final acceptance testing of all engineering services. This may take the form of spot checks on the installation being proposed for handover and compared with the test and environmental data obtained under Stage 3 commissioning. In the event that the spot checks are inconsistent with the test and environmental data the element in question shall be checked in its entirety. A check will also be made to ensure that the items raised on snagging lists have been cleared.

If the Contractor has to carry out testing and commissioning of the installation in sub-sections, as may be necessary for technical purposes or to suit the construction programme, then the Stage 4 Performance Testing can only be accepted when the whole building service proving has been carried out.

Additional tests shall be carried out as requested by the Engineer during the Defects Liability Period. Tests will only be requested if equipment is not performing as specified. Should it be found, after retesting, that the acceptable test criteria has not been maintained, then any additional cost incurred shall be borne by the Contractor.

The cost of any additional testing required by the Engineer to alter the performance of equipment which is operating in accordance with the original performance specification will not be borne by the Contractor.

In the event of the installation failing to pass the commissioning and test, the Contractor shall be responsible for all reasonable expenses incurred in repeating the tests.

All plant including standby equipment shall be tested to ensure that it is operating in accordance with the specified conditions and also that it is functioning in accordance with the control and interlocking sequences specified.

Adjustment and balancing of the systems shall, as far as possible, be done without the building being occupied or the systems being subjected to a full climatic cycle. Final adjustment and balancing to meeting a full climate cycle shall take place during the Defects Liability Period.

E7.8 Pipework Systems and Plant

Hydraulic Testing

The complete installation shall be pressure tested to the limits given in Clause M2.11.10. Safety valves, altitude or pressure gauges shall be isolated or removed during such tests.

The pressure shall be maintained as specified without measurable loss. Any defective joints, fittings or pipes disclosed by the test shall be remedied and any costs borne by the Contractor.

Certificates of all hydraulic tests made on site shall be signed by the Contractor and by the Engineer or his representative.

Heating Test

Heating and hot water installations shall, after successful hydraulic tests, be subjected to a heat test under operating conditions. The duration of each test shall be eight hours, during which time all the pipework, plant and pumps shall be subjected to the test, the systems allowed to cool and the heat test repeated a second time.

Following the heat test, no leaks should appear and the services should be examined to ensure the correct expansion and contraction takes place, similarly brackets and hangers shall be inspected and alignment checked.

These tests shall be applicable to all fittings, valves (which shall be in the open position) piping and equipment. The Contractor shall provide all skilled attention necessary during the warming up period to ensure all controls are operating correctly.

Balancing

The Contractor shall carry out balancing of all circuits, by the commissioning valves provided on a pressure basis. Design flow rates at the various points of the systems shall be established prior to balancing. Flow shall be regulated by the regulating valve and the pressure differences measured by means of a manometer fixed across the commissioning valve. The overall flow shall be checked by comparing differences across the valve with the valve manufacturers test curves. Flow through heating and cooling coils shall be measured as for the circuit balancing, by using the commissioning valves provided.

The Contractor shall include for all necessary pressure gauges and temperature tappings to enable the water circuits to be properly balanced and to determine the precise pressure losses across control valves, coils and items of major plant.

The systems shall be commissioned in accordance with the requirement of the CIBSE Commissioning Codes and BSRIA Application Guides.

Water Distribution	CIBSE Code W and BSRIA 2/89
Boiler Plant	CIBSE Code B
Refrigeration Systems	CIBSE Code R

Where it is not possible to exactly follow the aforementioned codes, the Contractor shall submit an alternative procedure for approval prior to commencement of commissioning.

Upon completion of the testing, balancing and operation of the installation, the Contractor shall take temperature readings in each room and submit these, together with corresponding readings of external conditions, in a tabulated form to the Engineer.

E7.9 Test Pressures

Pipeline Systems

The following procedures and test pressures shall be adopted unless specified otherwise in this specification.

Service	Test medium and Test period	Test pressure
Heating, Chilled Water, Condenser Water, Domestic Water services, Cold Feed and Expansion Vent	Water: 2 hours	1.5 times working or 6.5 bar whichever is the minimum
Overflows and Condensate drains	Water	Functional Test

E8 Automatic Controls And Wiring

The automatic controls and power wiring installation for the works shall be undertaken by a specialist controls company appointed at the earliest opportunity by the contractor. The recommended Control System Specialist is:

Contact: George Belfield, george@intandem.org.uk , 01489 877630.

www.intandem.org.uk

InTandem Systems Ltd
Unit D
Watton Farm
Watton Lane
Droxford
Southampton
Hampshire
SO32 3HA

The specialist shall carry out the detailed design, supply and installation of all controls, controls related elements and power wiring associated with the mechanical services installations.

PART F – Tender Deliverables

F1 Tender Breakdown

The Contractor shall complete the cost summary document in full. The successful Contractor shall provide quantified schedules of rates within 7 days of being appointed.

ITEM	DESCRIPTION	AMOUNT (£)
1.0	Preliminaries	
2.0	Surveys and validations	
3.0	LTHW pipework	
4.0	Chilled Water Pipework	
5.0	Ventilation Plant	
6.0	BMS/Controls	
7.0	Electrical Services	
8.0	Fire Alarm interface	
9.0	Roof support system	
10.0	Associated Builders Works	
11.0	Provision of Emergency Notices	
12.0	Provision of Fire Stopping	
13.0	Site surveys	
14.0	Testing and commissioning,	
15.0	Handover documentation	
PS01	Provisional Sum for potential additional requirements of building control	5,000.00
PS02	Provisional Sum for potential replacement of existing sub main cables currently serving existing MSCP's.	10,000.00
	Total	£

F2 Day Work Rates

Tenderers shall state below the percentage additions required on the Prime Cost of day works required to cover incidental costs, travelling time, expenses overheads and profit.

Labour	_____%
Materials	_____%
Plant	_____%
Contractors	_____%

Tenderers shall state below the categories of tradesmen to be employed, the actual hourly rate payable and the Prime Day work Cost for all working hours between 8.00am and 7.00pm, excluding weekend working:

<u>Tradesman</u>		<u>Nett Hourly Rate</u>	<u>Prime Cost Day Work</u>
Engineer	£ _____.	£ _____.
Electrician	£ _____.	£ _____.
Technician	£ _____.	£ _____.
Labourer	£ _____.	£ _____.

E3 Schedule of Rates

Tenderers shall note that the successful Services Contractor shall submit a quantified schedule of rates for the Works within 14 days of award of Contract.

E4 Tenderers Signature

Signed:

Print Name:

Position:

Date:

For and on behalf of:

E5 Other Information

Tenderers shall include additional pages of information should they deem it relevant to the project and for tendering purposes.