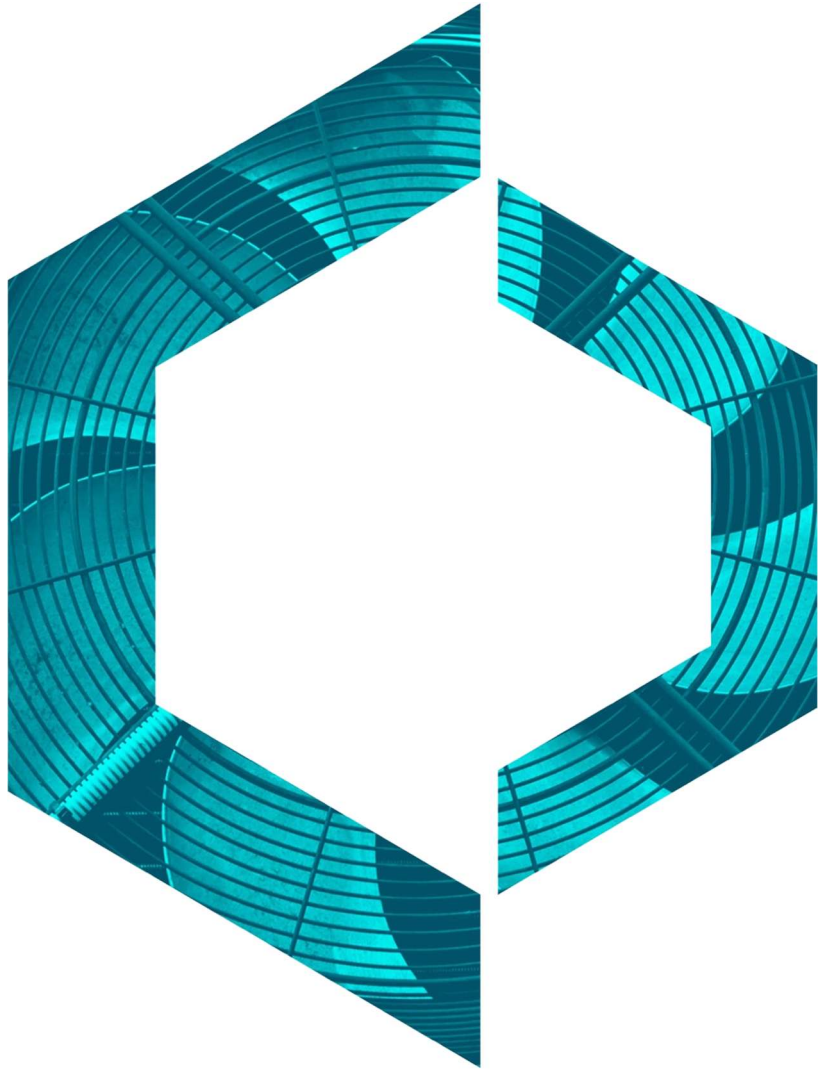




# Technical Specification Mechanical Services Installation

## AHU & Chiller Installation Beaumont Hospital

|                  |                           |
|------------------|---------------------------|
| Date             | 01/05/2026                |
| Report Revision  | 01                        |
| IN2 Project Ref: | B2605                     |
| Document Ref:    | B2605-IN2-ZZ-ZZ-SP-M-0001 |

Client



# Specifications Register – Mechanical Services

**Project Name** AHU & Chiller Installation  
**Project No.** B2605  
**Date** 13.05.26  
**Document Ref** B2506-IN2-ZZ-ZZ-SP-M-0001

| Section | Specification                                        | Rev | Date     | Issue |
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## 01.1 General

- 01.1.1 This section of the specification deals with the particular requirements for the mechanical services installations associated with the proposed AHU & Chiller Installation in Beaumont Hospital.
- 01.1.2 The proposed works comprise of the installation and commissioning of a new AHU and Chiller within the existing V6b plantroom and chiller compound
- 01.1.3 The contract works covered by this specification and accompanying drawings shall include the supply, installation, testing, commissioning and setting to work of the Mechanical inferred within this specification.
- 01.1.4 This Specification sets out the standards of materials to be used and standards of workmanship to be adopted for the mechanical services installation including that associated with electrical engineering services provided as part of this Contract.

## 01.2 Queries

- 01.2.1 Any Technical queries with respect to these specification requirements should be addressed to  
IN2 Design Engineering LTD  
5-23 Hill Street  
Belfast  
BT12LA  
Email: [conall.oneill@in2engineering.com](mailto:conall.oneill@in2engineering.com)

## 01.3 Scope of Works

- 01.3.1 The contractor shall carry out all necessary works required to implement the proposed systems referred to in the Tender specification and those identified on the Tender drawings. These works shall include, but not necessarily be limited to, complete procurement, provision, planning, delivery, off-loading/craneage, storage, erection, installation, setting to work, testing, commissioning etc. of all materials to provide an effective and safe working installation inferred by this specification.
- 01.3.2 The contractor shall include for all works and materials, including those not directly specified but are necessary to complete the proposed works.
- 01.3.3 It is deemed that a contractor site visit is performed prior to submitting tendering costs to familiarise themselves with the project and Beaumont Hospital.
- 01.3.4 Inclusions for transport of all plant, materials and equipment to site, including all labouring, freightage, unpacking, storage and assembly, shall be made.
- 01.3.5 The contractor shall, wherever necessary, pay all fees to manufacturers, suppliers, inspectors etc for attendance, commissioning, installation, testing and any other necessary fees to fully install all mechanical plant included within the works and this contract.

- 01.3.6 The contractor is responsible for ensuring that all plant and equipment is fully coordinated, including that all plant, pipework, ductwork, air terminal devices and all ancillaries can fit within the proposed ceiling voids, plant areas and risers.
- 01.3.7 The contractor shall ensure that all plant equipment follows the manufacturer's guidelines, including maintenance and clearance zones for all plant such as Chillers and Air handling units, are followed. The contractor shall ensure that the routing of pipework, ductwork, containment and positioning of any equipment do not obstruct or prevent effective operation of equipment, including those installed by others.
- 01.3.8 The contract shall liaise with the architect, fire engineer and all other relevant parties to ensure the approval of all relevant documentation needed to demonstrate all relevant compliances such as Building Controls and Health Technical Memoranda.

## 01.4 Extent of Works

- 01.4.1 As a summary, the works described within this specification and drawings are to include:
- Replacement of existing AHUs and chiller plant as scheduled.
  - Associated builders works, lifting operations, access provisions, removals and disposal.
  - Modifications to pipework, ductwork, drainage, power supplies and controls as required.
  - Integration with existing BMS and controls systems.
  - Testing, flushing, commissioning and performance demonstration.
  - Provision of O&M manuals, as-built drawings and training.
  - Provision of recommended spare filters, belts and critical spares.
  - Compliance with all applicable Building Regulations, HTM guidance, health & safety legislation and current industry standards.
  - Contractor to include all delivery logistics, craneage, permits, traffic management and out-of-hours working as necessary.
  - Works to be completed with minimum disruption to hospital operations.
- 01.4.2 Costs involved with any plant deliveries such as road closures or negotiations with relevant parties to organise said deliveries, shall be included.
- 01.4.3 The design and installation shall be carried out in full compliance with the current rules, regulations and recommendations issued by the local authorities, building regulations, fire offices, health and safety executives, and all relevant NHS Heat Technical Memoranda (HTM) and associated healthcare engineering guidance applicable to the works.
- 01.4.4 All equipment, materials and workmanship shall meet the following documents and standards unless otherwise indicated within this specification:
- CIBSE commissioning codes
  - HVCA Ductwork Specifications standards DW 144 and DW 171
  - Technical Guidance Documents
  - The local Fire officers requirements

- HTM 00, HTM 03, HTM 04, HTM 05 and any other applicable HTM guidance documents

## 01.5 Health and Safety

- 01.5.1 All works shall be carried out in accordance with the requirements of the Health and Safety Commission, including all statutory instruments, instructions, and recommendations issued by the Commission or the Health and Safety Executive.
- 01.5.2 The Construction (Design and Management) Regulations shall be adhered to throughout the execution of the works. All directions issued by the Principal Contractor and the provisions of the approved Health and Safety Plan shall be fully followed.
- 01.5.3 The installation shall be executed to incorporate all reasonable measures and safeguards necessary to ensure the safety of personnel involved in the operation, maintenance, and interface with associated works provided by others.

## 01.6 Tenders

- 01.6.1 Tenders shall be submitted on the forms provided.
- 01.6.2 Tenders shall be fully compliant with the requirements of this Specification. Should the Tenderer wish to put forward an alternative for consideration, it shall be submitted under separate cover with a full description of the proposal, detailing all deviations from the Specification and any associated cost implications.

## 01.7 Standards of Workmanship

- 01.7.1 All workmanship and materials shall be of the highest standard and to the complete satisfaction of the Engineer or their representative. Any element of the works or materials deemed to fall short of the required standard shall be replaced by the Contractor within seven days, at no additional cost to the Contract.

## 01.8 Final positioning

- 01.8.1 The routes of all cables, pipes, ducts and the positions of all outlets and equipment shown on the drawings shall be considered correct for tender purposes. It is, however, the Contractor's responsibility to develop these in accordance with this brief and, once approved, agree the final positions on site with the Engineer or their representative prior to installation. Scaling of dimensions from drawings shall not be undertaken.

## 01.9 As Built Drawings

- 01.9.1 It is the Contractors responsibility to ensure that the mechanical services indicated comply fully with this specification and that they co-ordinate with all other services and the building structure. The Contractor shall provide their own installation drawings for approval/co-ordination etc. including the following:
- Site Services Drawing

- Heating and cooling layouts
  - Ventilation layouts
  - Any relevant mechanical schematics
- 01.9.2 The Contractor shall prepare installation/working drawings detailing the proposed execution of the works. These drawings shall provide sufficient detail to allow the works to be installed correctly and shall include all necessary setting-out dimensions. The Contractor shall be responsible for producing all working details and fabrication information required to coordinate pipework, ductwork, plant, and electrical services, ensuring all systems fit appropriately within ceiling voids, service risers, switch rooms, and plant areas.
- 01.9.3 In preparing the installation drawings, the Contractor shall take full account of the most recent Architectural and Structural arrangement drawings and models. The Contractor shall incorporate any adjustments necessary to ensure compliance with updated Architectural or Structural model and layouts.

## 01.10 Plant access and maintenance

- 01.10.1 The Contractor shall take full account of all access limitations arising from access shafts and the general access routes indicated on the Architect's and Engineer's drawings for the building and associated services layouts.

## 01.11 Craneage

- 01.11.1 The Contractor shall be responsible for the complete planning, coordination, provision and execution of all craneage and lifting operations required for the removal of existing plant and the delivery, lifting, positioning and installation of the new chiller and air handling unit
- 01.11.2 All lifting operations shall be carried out by a competent specialist lifting contractor and in full accordance with current statutory requirements, including applicable health and safety legislation, LOLER, PUWER and relevant codes of practice
- 01.11.3 The Contractor shall ensure that:
- The selected crane(s), lifting accessories and associated equipment are suitable for the duty, site constraints, lifting range, access limitations and the verified weights and dimensions of all plant items to be removed and installed.
  - Full confirmation of plant operating weights, dry weights, lifting points and centre of gravity shall be obtained from manufacturers prior to lifting operations.
  - Detailed lift plans, method statements, risk assessments and temporary works proposals (where required) shall be prepared and submitted for review in advance of the works.
  - All road closures, permits, traffic management measures, exclusion zones, pavement closures and local authority approvals required for crane operations shall be obtained and managed by the Contractor.
  - All lifting operations shall be coordinated with Beaumont Hospital Estates and undertaken at agreed times to minimise disruption to hospital operations, emergency access routes, staff, patients and visitors.

- Works shall be programmed to maintain continuity of existing services as far as practicable and avoid unnecessary shutdowns or disturbance to critical clinical areas.
- Adequate protection shall be provided to roofs, structures, finishes, surrounding services and public areas during lifting operations.
- The Contractor shall allow for all ancillary items including mobile cranes, contract lifts, banksmen, appointed persons, slingers/signallers, lifting frames, spreader beams, mats, hoarding and traffic marshals as necessary for a complete installation.

01.11.4 Any out-of-hours working, weekend lifting operations or special access requirements necessary to reduce disruption shall be deemed included within the summary of tender documentation.

## 01.12 Builder's Works

- 01.12.1 The Contractor shall note that all Builders Work in connection with the services is the responsibility of the Main Contractor. However, the Contractor shall provide all necessary information and maintain close liaison with the Main Contractor to ensure the satisfactory and timely completion of the works. This responsibility includes supplying full details of all floor slab and wall penetrations, required pattresses, and any builders work associated with plant, ductwork, and pipework distribution.
- 01.12.2 Particular attention shall be given to Builders Work requirements within the plantroom and at all roof levels. Early coordination is essential to ensure that all necessary Builders Work requirements are incorporated into the project at the earliest possible stage.
- 01.12.3 The Contractor shall prepare detailed Builders Work drawings indicating all requirements, fully dimensioned and coordinated with Architectural and Structural layouts.



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## 02.1 Standards

- 00.1.1 All goods, products and materials shall be in accordance with the latest revision of Irish and EU Standards.
- 00.1.2 The Mechanical Contractor shall carefully read the notes on the drawings and include for all associated costs in his tender.
- 00.1.3 The complete installation shall comply with the latest codes of practice and any other legal requirements applicable to any element of materials, equipment and services provided under this contract, even if an applicable code or legal requirement is not specifically referenced in the contract documents.

## 02.2 Materials

- 02.2.1 All products, materials and equipment shall comply with the project specification, as well as referenced standards and all applicable regulatory requirements.
- 02.2.2 Similar items of equipment and individual materials shall be selected from one manufacturer's range to standardise appearance, compatibility, maintenance and replacement.
- 02.2.3 Unless otherwise indicated, standard manufacturer's finishes and colours are to be provided.
- 02.2.4 All materials, products and equipment are to be transported, handled, lifted, hoisted and stored in accordance with the manufacturer's guidelines to prevent damage to equipment and injury to persons.
- 02.2.5 The manufacturer's installation recommendations shall be followed and adhered to in full including any requirements for additional or ancillary components not explicitly specified but recommended to complete the installations ensuring suitability for purpose.

## 02.3 Co-ordination and Liaison with other Trades

- 02.3.1 The Contractor shall be responsible for co-ordination of his works with other Contractors and sub-Contractors and determine and advise of necessary builders work and attendances.
- 02.3.2 The Contractor shall co-ordinate space requirements with other services in accordance with routing shown on drawings and utilise space efficiently to maximise accessibility for other installations and for future access and maintenance.
- 02.3.3 The Contractor shall review mechanical and electrical layouts with other Contractors prior to any installation.
- 02.3.4 The Contractor will make available the appropriate personnel for attendance at site co-ordination meetings.
- 02.3.5 The Contractor shall include for the production at an early stage of co-ordinated services layout drawings including sectional details of all primary services routes. These drawings shall be fully co-ordinated between mechanical and electrical Contractors and shall be issued to the Main Contractor and Engineer for approval before the installation of any works proceeds.

- 02.3.6 The Mechanical Contractor shall act as M&E services coordinator for all works within their scope. Coordination shall include maintenance access zones, filter removal routes, valve access, safe shutdown arrangements and replacement plant removal / installation paths.
- 02.3.7 The Electrical Contractor shall be responsible for detailing all primary electrical services and producing specific installation details and drawings which shall be provided to the mechanical contractor for inclusion in the final coordination drawings.
- 02.3.8 Any works undertaken resulting in critical dimensions not being achieved (for example ceiling voids) or requiring alterations of architectural finishes where co-ordinated drawings have not been produced and agreed with the design team will be removed and reinstated to design team satisfaction at the Contractor's expense.
- 02.3.9 Any installations undertaken by the Contractor resulting in less than satisfactory appearance or improper works in the opinion of the Engineer where insufficient coordination has taken place shall be fully removed and rectified at the Contractor's expense. (e.g. pipework crossing or in proximity to electrical distribution or comms equipment etc.)

## 02.4 Production of Information - Procurement Details

- 02.4.1 The Contractor shall refer to individual sections of the specification and where requested, the Contractor shall provide full shop drawings and complete technical submittal documentation at an early stage to allow appropriate time for review and consideration of the information provided. The Engineer will endeavour to return comment or acceptance of proposals within 10 days of receipt of full submittals. The Contractor shall note that the programme implications of inadequate notice or late provision of information regarding submittals cannot be accepted by the Engineer.
- 02.4.2 The Contractor shall in advance of ordering any equipment submit a full and complete procurement schedule listing all items being procured providing the following information to the Engineer.
- Plant Item including specific Reference Name or identification.
  - Returned relevant section of IN2 specification, with each line item marked 'compliant' or 'non-compliant' by supplier/manufacturer.
  - Manufacturer / Supplier Information.
  - Lead time for delivery.
- 02.4.3 On receipt of the above information the Engineer reserves the right to request further information including technical data sheets or shop drawings in order to be fully satisfied of the Contractor's intent.

## 02.5 Production of Information - Builders Works and Attendances

- 02.5.1 The Contractor shall refer to preliminary Builders Works drawings prepared "for Information" by IN2 Engineering Design Partnership. The Contractor shall take ownership of and shall develop these drawings as the "Contractors" Builders Works Drawings incorporating all Builders Works required to be provided on behalf of the Contractor by the Main Contractor. The Contractor's Builders Works Drawings shall contain all necessary information including dimensional and setting out details.
- 02.5.2 The drawings shall include 1:20 and 1:50 sections and details clearly identifying the Contractors requirements to provide a full working installation in compliance with this specification, manufacturers' guidelines and industry good practice.

## 02.6 Quality Control and Workmanship

- 02.6.1 The Contractor shall be responsible for on-site installation quality control. As such the Contractor will implement and maintain high standards of quality control governing materials and equipment, project management, site conditions and workmanship to provide a complete working installation to the highest standards that can be reasonably expected or attained.
- 02.6.2 Evidence of quality control procedures being in place must be demonstrated in this regard.
- 02.6.3 Only persons suitably trained with the necessary qualifications and experience appropriate to the task shall carry out installation works.
- 02.6.4 In recognition of the requirement to effectively train apprentices in the trade skill, workmanship and experience and to ensure the highest standards of installations reasonably attainable, the Contractor shall ensure that a ratio of two apprentices to each qualified trades-person is not exceeded on site.
- 02.6.5 Evidence will be requested to demonstrate compliance in this regard.
- 02.6.6 The Contractor shall execute his works in accordance with industry standards and any relevant guidelines offered by codes of practice or applicable regulations.
- 02.6.7 The Contractor shall establish and implement manufacturers' installation instructions and procedures in full.
- 02.6.8 The Consulting Engineers reserve the right to observe ongoing and completed work and comment there on, without prejudice, to the Contractor's responsibility for quality control.
- 02.6.9 Defective or sub-standard installations or workmanship shall be rectified at the expense of the Contractor

## 02.7 Testing & Inspections

- 02.7.1 The Contractor shall be responsible for a carrying out all commissioning, testing and inspections as required by the specification or by any governing regulations or codes of practice not specifically referenced in the documentation.

- 02.7.2 The Contractor shall maintain an accurate documented record of all commissioning and test results to include the type of test carried out, listing all observations and findings including defects and failures. The documentation shall also give details of proposed or instructed remedial actions taken to correct any defects or failures. A retest of all failures shall be documented.
- 02.7.3 The Contractor shall prepare a written schedule giving a **minimum 10 day** notice period of proposed test dates for witnessing by the Engineer and Client's representative.
- 02.7.4 The Contractor shall provide the original Test and Compliance Certificates for inclusion in the O&M Manual. These certificates must be presented prior to Practical Completion Stage, as failure to do so will delay practical completion and all costs for delays attributable will be borne by the Contractor.
- 02.7.5 Where required by the Specification the Contractor will be obliged to engage third party testing and commissioning specialists. The proposed third party details together with the scope of their engagement shall be submitted to Engineer for comment or approval by the Contractor no less than 1 calendar month before the programmed pre-commissioning dates.
- 02.7.6 The Contractor shall prepare a detailed schedule and commissioning programme identifying tasks, durations and sequence together with key dates for co-ordination with the Main Contract Programme. The Contractor shall ensure that sufficient time is allocated within the Main Contract programme for successful and complete testing commissioning and witness testing.

## 02.8 Site Facilities

- 02.8.1 The Contractor will provide secure covered storage facilities for all materials and equipment necessary for the proper execution of the contract. The Contractor shall allow for deliveries of materials and equipment commensurate to the space available. All costs associated with site storage will be deemed to be included within the tender return. The Contractor shall co-ordinate site facility requirements in line with the main contractor's compound
- 02.8.2 The Engineer may reject materials or equipment where it is considered that these materials are not being stored adequately and protected from damage and these will be replaced at the Contractor's own expense.
- 02.8.3 The Contractor shall provide site office facilities complete with telephone, fax, and e-mail capabilities for receipt of design information. The Contractor shall also include for the provision of on-site CAD facilities complete with A0 colour plotting facilities.

## 02.9 Site Supervision

- 02.9.1 The Contractor shall include for the provision of a full time, on site, suitably experienced Foreman whose time and responsibility will be dedicated solely to the project for the supervision of trades-persons under his control. The Foreman shall not be involved in installation works as a trades-person.
- 02.9.2 Chargehands with responsibility for separately identifiable elements of the installation shall also be provided as required.

- 02.9.3 The Contractor shall include for the provision of a suitably experienced Contracts Manager with overall responsibility of the project. The Contracts Manager will be expected to be present on site for a minimum of 2 days per week coinciding with site meetings.
- 02.9.4 As works progress the requirement may increase to full time attendance of the Contracts Manager and allowances shall be made for same.

## 02.10 Operation and Maintenance Manuals

- 02.10.1 Preparation of operating and maintenance manuals shall be based on the following documents:-
- BSRIA Technical Note TN 1/84; Guidelines for building services operating and maintenance manuals
  - BSRIA Application Guide 1/87; Operating and maintenance manuals for building services installations
  - BSRIA Technical Note TN 12/86; Fault finding procedures in the building services industry
- 02.10.2 2 No. weeks prior to practical completion of the contract, the Contractor shall submit a preliminary draft set of Operation and Maintenance Manuals, to the Engineer for comment.
- 02.10.3 After final approval from the Engineer and before making application for final payments, the Contractor shall present 2 No. corrected hard bound copies of the approved Operation and Maintenance Manual to form part of the Health and Safety File.
- 02.10.4 The Operation and Maintenance Manual shall contain the following as a minimum;
- Index, introduction and safety of work.
  - Outline description of the installation completed
  - Description of all systems, their operational procedures and associated equipment.
  - Names, addresses and telephone numbers of all sub-contractors, specialist suppliers and local firms/agents for each item installed.
  - Original copies of all plant, component and technical documentation.
  - Equipment schedules and spare parts lists.
  - Operating information.
  - Maintenance instructions.
  - Schedules of Preventative maintenance identifying tasks and timeframes.
  - Fault finding/diagnostics for the completed systems.
  - Original copies of all system and plant test certificates and commissioning certificates.
  - Complete commissioning data for all systems cross referenced to the design schedules.
  - Complete set of full size (A0/A1) colour drawings

- Complete and bound set of reduced size (A3) colour drawings
- AutoCAD format 'As Built' drawings of the completed installations presented on DVD format.

The contractor shall provide an Electronic copy of the final and agreed O&M Manual including all technical literature and 'As Installed' drawing information etc. All text shall be presented on Microsoft Word (latest version) files or PDF. All manufacturers' literature, catalogue information etc shall be scanned and presented in PDF format. The electronic copy shall be submitted on DVD format.

02.10.5 The Client shall reserve the right to engage the services of a specialist author to prepare the Operating and Maintenance manuals, should the contractor fail to provide a full set of complete comprehensive Operation and Maintenance Manuals to the satisfaction of the Client and Engineer. The cost of the specialist author shall be deducted from retention or monies outstanding.

## 02.11 Handover

- 02.11.1 The Contractor shall be available for attendance at a formal handover and presentation of the O&M Manuals to the client and a date and time to be advised by the consulting engineer. The Contractor will be expected to demonstrate a working understanding of the installed systems to a level that can be conveyed to the client to enable him to operate the systems and installations to their full potential with confidence.
- 02.11.2 Post Handover and for an initial "run-in" period following occupation of no less than 1 week the Contractor shall maintain an on-site presence of appropriate persons to ensure the seamless transition for the new occupants.
- 02.11.3 Following handover the Contractor shall attend monthly review meetings on site to deal with any arising issues and ensure identified "snag" items are being actioned.

## 02.12 Maintenance Period

- 02.12.1 The Contractor shall maintain the Mechanical Services Installation for a period of twelve (12 No.) calendar months commencing from the date of issue of a certificate of practical completion by the Architect.
- 02.12.2 The Contractor shall at Handover nominate a responsible person who shall liaise directly with the building operator on all matters associated with maintenance for the duration of this period.
- 02.12.3 The Contractor shall include for 6 no. Bi-monthly PPM (Planned Preventative Maintenance) visits during the maintenance period. Such visits shall include for checking the operation of mechanical plant, equipment, accessories etc., making all necessary adjustments and carrying out all necessary replacement of any such faulty component, incidental to this Contract. All maintenance shall be undertaken in accordance with the recommendations as set out in the O&M Manuals.
- 02.12.4 All visits shall be scheduled to occur at times suitable to the client.

- 02.12.5 In additional to the PPM visits, The Contractor shall also provide an Emergency Service during the whole of the Maintenance Period. The Contractor will be expected to provide a same-day response service (with a following-day service being acceptable for less critical issues in the mutual opinion of the operator and Contractor at the time). Where the cause for the call out was not a result of a defective component under the terms of the defects liability or manufacturer's warranty the Contractor will be entitled to seek costs for the call out. Call Out rates to be clearly identified and agreed at handover. Call out charges will be billed directly to the building operator.
- 02.12.6 The PPM scope shall include but not be restricted to the following;
- Maintenance of Cooling Systems including overseeing annual plant maintenance, re-adjusting water balancing as required, removing air from systems, cleaning dirt/ air separator filters etc.
  - Maintenance of Ventilation Systems including replacement of both panel and bag filters to Air Handling Units, checking/ replacing fan belts as required, checking fan operation, checking dampers are open etc.
  - The costs of providing all maintenance including where necessary works required to be undertaken by specialists or third parties is deemed included in the Tender.
- 02.12.7 The following maintenance elements are deemed excluded from the requirements of this specification, however this may be undertaken at additional cost and if agreed between the Contractor and building operator;
- Portable Appliance Testing.
  - Provision of Consumables (over and above those listed as spares in the specification).
  - Maintenance of client provided equipment.
- 02.12.8 Following each PPM visit (including those of any specialist) the Contractor shall issue a report to be signed by a representative of the building operator, before being submitted to the Engineer. The report shall include brief details of the visit, including, who attended site, the works undertaken, the time duration etc.
- The report shall identify the condition of plant and equipment, list the maintenance undertaken and highlight any issue that may require further



remedial action but was not possible to address within the context of the PPM visit.

- 02.12.9 In the event of the Contractor failing to carry out the PPM within reasonable time frames, the Contractor will be advised that these works will be undertaken by others appointed by the client and all associated costs will be deducted from retention or other monies outstanding.

## 02.13 Defects Liability

- 02.13.1 During the Maintenance period any defect developed in the Mechanical Services Installations during this period shall be rectified and made good at the Contractor's own expense. Exceptions will only be made where it is evident that the cause can be seen to be outside the Contractors control.
- The term defect in shall be interpreted as:
  - 'any item of plant, equipment or component thereof, accessory or fitting that shall be found defective, show signs of mechanical or electrical weakness or undue wear in consequence of faulty design, workmanship or material'.
- 02.13.2 In the event of the Contractor refusing to rectify such defects within a reasonable period, the Engineers will have the works carried out by others, and any charges arising there from shall be at the expense of the Contractor and deducted from retention monies.

## 02.14 Controls Devices

- 02.14.1 The Mechanical Contractor shall be responsible for installing all control devices to both pipework and ductwork systems.
- 02.14.2 The Mechanical Contractor shall install controls devices immediately prior to commissioning stage. Sensor pockets only shall be installed at first/second fix stages to enable pressure testing etc. to be completed.

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## 03.1 Standards

- 01.1.1 All goods, products and materials shall be in accordance with the latest revision of Irish and EU Standards.
- 01.1.2 The Mechanical Contractor shall carefully read the notes on the drawings and include for all associated costs in his tender.
- 01.1.3 The complete installation shall comply with the latest codes of practice and any other legal requirements applicable to any element of materials, equipment and services provided under this contract, even if an applicable code or legal requirement is not specifically referenced in the contract documents.

## 03.2 Materials

- 03.2.1 All products, materials and equipment shall comply with the project specification, as well as referenced standards and all applicable regulatory requirements.
- 03.2.2 Similar items of equipment and individual materials shall be selected from one manufacturer's range to standardise appearance, compatibility, maintenance and replacement.
- 03.2.3 Unless otherwise indicated, standard manufacturer's finishes and colours are to be provided.
- 03.2.4 All materials, products and equipment are to be transported, handled, lifted, hoisted and stored in accordance with the manufacturer's guidelines to prevent damage to equipment and injury to persons.
- 03.2.5 The manufacturer's installation recommendations shall be followed and adhered to in full including any requirements for additional or ancillary components not explicitly specified but recommended to complete the installations ensuring suitability for purpose.

## 03.3 Co-ordination and Liaison with other Trades

- 03.3.1 The Contractor shall be responsible for co-ordination of his works with other Contractors and sub-Contractors and determine and advise of necessary builders work and attendances by the Main Contractor.
- 03.3.2 The Contractor shall co-ordinate space requirements with other services in accordance with routing shown on drawings and utilise space efficiently to maximise accessibility for other installations and for future access and maintenance.
- 03.3.3 The Contractor shall review mechanical and electrical layouts with other Contractors prior to any installation.
- 03.3.4 The Contractor will make available the appropriate personnel for attendance at site co-ordination meetings.
- 03.3.5 The Contractor shall include for the production at an early stage of co-ordinated services layout drawings including sectional details of all primary services routes. These drawings shall be fully co-ordinated between mechanical and electrical Contractors and shall be issued to the Main Contractor and Engineer for approval before the installation of any works proceeds.

- 03.3.6 The Mechanical Contractor shall act as lead co-ordinator and be responsible for presenting agreed co-ordinated mechanical and electrical layouts to the design team. These should include for detailed plans and sections, indicating how all potential clashes with structure, architectural finishes and other services (whether responsibility of Mechanical Contractor or not) have been overcome accordingly. The Mechanical Contractor shall be responsible for obtaining and collating all requisite information from the Electrical Contractor, or any other relevant Sub-Contractor (i.e. natural ventilation / rainwater etc.)
- 03.3.7 The Electrical Contractor shall be responsible for detailing all primary electrical services and producing specific installation details and drawings which shall be provided to the mechanical contractor for inclusion in the final coordination drawings.
- 03.3.8 Any works undertaken resulting in critical dimensions not being achieved (for example ceiling voids) or requiring alterations of architectural finishes where co-ordinated drawings have not been produced and agreed with the design team will be removed and reinstated to design team satisfaction at the Contractor's expense.
- 03.3.9 Any installations undertaken by the Contractor resulting in less than satisfactory appearance or improper works in the opinion of the Engineer where insufficient coordination has taken place shall be fully removed and rectified at the Contractor's expense. (e.g. pipework crossing or in proximity to electrical distribution or comms equipment etc.)

## 03.4 Production of Information - Procurement Details

- 03.4.1 The Contractor shall refer to individual sections of the specification and where requested, the Contractor shall provide full shop drawings and complete technical submittal documentation at an early stage to allow appropriate time for review and consideration of the information provided. The Engineer will endeavour to return comment or acceptance of proposals within 10 days of receipt of full submittals. The Contractor shall note that the programme implications of inadequate notice or late provision of information regarding submittals cannot be accepted by the Engineer.
- 03.4.2 The Contractor shall in advance of ordering any equipment submit a full and complete procurement schedule listing all items being procured providing the following information to the Engineer.
- Plant Item including specific Reference Name or identification.
  - Returned relevant section of IN2 specification, with each line item marked 'compliant' or 'non-compliant' by supplier/manufacturer.
  - Manufacturer / Supplier Information.
  - Lead time for delivery.
- 03.4.3 On receipt of the above information the Engineer reserves the right to request further information including technical data sheets or shop drawings in order to be fully satisfied of the Contractor's intent.

## 03.5 Production of Information - Builders Works and Attendances

- 03.5.1 The Contractor shall refer to preliminary Builders Works drawings prepared "for Information" by IN2 Engineering Design Partnership. The Contractor shall take
- 03.5.2 ownership of and shall develop these drawings as the "Contractors" Builders Works Drawings incorporating all Builders Works required to be provided on behalf of the Contractor by the Main Contractor. The Contractor's Builders Works Drawings shall contain all necessary information including dimensional and setting out details.
- 03.5.3 The drawings shall include 1:20 and 1:50 sections and details clearly identifying the Contractors requirements to provide a full working installation in compliance with this specification, manufacturers' guidelines and industry good practice.

## 03.6 Quality Control and Workmanship

- 03.6.1 The Contractor shall be responsible for on-site installation quality control. As such the Contractor will implement and maintain high standards of quality control governing materials and equipment, project management, site conditions and workmanship to provide a complete working installation to the highest standards that can be reasonably expected or attained.
- 03.6.2 Evidence of quality control procedures being in place must be demonstrated in this regard.
- 03.6.3 Only persons suitably trained with the necessary qualifications and experience appropriate to the task shall carry out installation works.
- 03.6.4 In recognition of the requirement to effectively train apprentices in the trade skill, workmanship and experience and to ensure the highest standards of installations reasonably attainable, the Contractor shall ensure that a ratio of two apprentices to each qualified trades-person is not exceeded on site.
- 03.6.5 Evidence will be requested to demonstrate compliance in this regard.
- 03.6.6 The Contractor shall execute his works in accordance with industry standards and any relevant guidelines offered by codes of practice or applicable regulations.
- 03.6.7 The Contractor shall establish and implement manufacturers' installation instructions and procedures in full.
- 03.6.8 The Consulting Engineers reserve the right to observe ongoing and completed work and comment there on, without prejudice, to the Contractor's responsibility for quality control.
- 03.6.9 Defective or sub-standard installations or workmanship shall be rectified at the expense of the Contractor

## 03.7 Testing & Inspections

- 03.7.1 The Contractor shall be responsible for carrying out all commissioning, testing and inspections as required by the specification or by any governing regulations or codes of practice not specifically referenced in the documentation.

- 03.7.2 The Contractor shall maintain an accurate documented record of all commissioning and test results to include the type of test carried out, listing all observations and findings including defects and failures. The documentation shall also give details of proposed or instructed remedial actions taken to correct any defects or failures. A retest of all failures shall be documented.
- 03.7.3 The Contractor shall prepare a written schedule giving a **minimum 10 day** notice period of proposed test dates for witnessing by the Engineer and Client's representative.
- 03.7.4 The Contractor shall provide the original Test and Compliance Certificates for inclusion in the O&M Manual. These certificates must be presented prior to Practical Completion Stage, as failure to do so will delay practical completion and all costs for delays attributable will be borne by the Contractor.
- 03.7.5 Where required by the Specification the Contractor will be obliged to engage third party testing and commissioning specialists. The proposed third party details together with the scope of their engagement shall be submitted to Engineer for comment or approval by the Contractor no less than 1 calendar month before the programmed pre-commissioning dates.
- 03.7.6 The Contractor shall prepare a detailed schedule and commissioning programme identifying tasks, durations and sequence together with key dates for co-ordination with the Main Contract Programme. The Contractor shall ensure that sufficient time is allocated within the Main Contract programme for successful and complete testing commissioning and witness testing.

## 03.8 Site Facilities

- 03.8.1 The Contractor will provide secure covered storage facilities for all materials and equipment necessary for the proper execution of the contract. The Contractor shall allow for deliveries of materials and equipment commensurate to the space available. All costs associated with site storage will be deemed to be included within the tender return. The Contractor shall co-ordinate site facility requirements in line with the main contractor's compound
- 03.8.2 The Engineer may reject materials or equipment where it is considered that these materials are not being stored adequately and protected from damage and these will be replaced at the Contractor's own expense.
- 03.8.3 The Contractor shall provide site office facilities complete with telephone, fax, and e-mail capabilities for receipt of design information. The Contractor shall also include for the provision of on-site CAD facilities complete with A0 colour plotting facilities.

## 03.9 Site Supervision

- 03.9.1 The Contractor shall include for the provision of a full time, on site, suitably experienced Foreman whose time and responsibility will be dedicated solely to the project for the supervision of trades-persons under his control. The Foreman shall not be involved in installation works as a trades-person.
- 03.9.2 Chargehands with responsibility for separately identifiable elements of the installation shall also be provided as required.

- 03.9.3 The Contractor shall include for the provision of a suitably experienced Contracts Manager with overall responsibility of the project. The Contracts Manager will be expected to be present on site for a minimum of 2 days per week coinciding with site meetings.
- 03.9.4 As works progress the requirement may increase to full time attendance of the Contracts Manager and allowances shall be made for same.

## 03.10 Operation and Maintenance Manuals

- 03.10.1 Preparation of operating and maintenance manuals shall be based on the following documents:-
- BSRIA Technical Note TN 1/84; Guidelines for building services operating and maintenance manuals
  - BSRIA Application Guide 1/87; Operating and maintenance manuals for building services installations
  - BSRIA Technical Note TN 12/86; Fault finding procedures in the building services industry
- 03.10.2 2 No. weeks prior to practical completion of the contract, the Contractor shall submit a preliminary draft set of Operation and Maintenance Manuals, to the Engineer for comment.
- 03.10.3 After final approval from the Engineer and before making application for final payments, the Contractor shall present 2 No. corrected hard bound copies of the approved Operation and Maintenance Manual to form part of the Health and Safety File.
- 03.10.4 The Operation and Maintenance Manual shall contain the following as a minimum;
- Index, introduction and safety of work.
  - Outline description of the installation completed
  - Description of all systems, their operational procedures and associated equipment.
  - Names, addresses and telephone numbers of all sub-contractors, specialist suppliers and local firms/agents for each item installed.
  - Original copies of all plant, component and technical documentation.
  - Equipment schedules and spare parts lists.
  - Operating information.
  - Maintenance instructions.
  - Schedules of Preventative maintenance identifying tasks and timeframes.
  - Fault finding/diagnostics for the completed systems.
  - Original copies of all system and plant test certificates and commissioning certificates.
  - Complete commissioning data for all systems cross referenced to the design schedules.
  - Complete set of full size (A0/A1) colour drawings

- Complete and bound set of reduced size (A3) colour drawings
- AutoCAD format 'As Built' drawings of the completed installations presented on DVD format.

The contractor shall provide an Electronic copy of the final and agreed O&M Manual including all technical literature and 'As Installed' drawing information etc. All text shall be presented on Microsoft Word (latest version) files or PDF. All manufacturers' literature, catalogue information etc shall be scanned and presented in PDF format. The electronic copy shall be submitted on DVD format.

- 03.10.5 The Client shall reserve the right to engage the services of a specialist author to prepare the Operating and Maintenance manuals, should the contractor fail to provide a full set of complete comprehensive Operation and Maintenance Manuals to the satisfaction of the Client and Engineer. The cost of the specialist author shall be deducted from retention or monies outstanding.

## 03.11 Handover

- 03.11.1 The Contractor shall be available for attendance at a formal handover and presentation of the O&M Manuals to the client and a date and time to be advised by the consulting engineer. The Contractor will be expected to demonstrate a working understanding of the installed systems to a level that can be conveyed to the client to enable him to operate the systems and installations to their full potential with confidence.
- 03.11.2 Post Handover and for an initial "run-in" period following occupation of no less than 1 week the Contractor shall maintain an on-site presence of appropriate persons to ensure the seamless transition for the new occupants.
- 03.11.3 Following handover the Contractor shall attend monthly review meetings on site to deal with any arising issues and ensure identified "snag" items are being actioned.

## 03.12 Maintenance Period

- 03.12.1 The Contractor shall maintain the Mechanical Services Installation for a period of twelve (12 No.) calendar months commencing from the date of issue of a certificate of practical completion by the Architect.
- 03.12.2 The Contractor shall at Handover nominate a responsible person who shall liaise directly with the building operator on all matters associated with maintenance for the duration of this period.
- 03.12.3 The Contractor shall include for 6 no. Bi-monthly PPM (Planned Preventative Maintenance) visits during the maintenance period. Such visits shall include for checking the operation of mechanical plant, equipment, accessories etc., making all necessary adjustments and carrying out all necessary replacement of any such faulty component, incidental to this Contract. All maintenance shall be undertaken in accordance with the recommendations as set out in the O&M Manuals.
- 03.12.4 All visits shall be scheduled to occur at times suitable to the client.



- 03.12.5 In additional to the PPM visits, The Contractor shall also provide an Emergency Service during the whole of the Maintenance Period. The Contractor will be expected to provide a same-day response service (with a following-day service being acceptable for less critical issues in the mutual opinion of the operator and Contractor at the time). Where the cause for the call out was not a result of a defective component under the terms of the defects liability or manufacturer's warranty the Contractor will be entitled to seek costs for the call out. Call Out rates to be clearly identified and agreed at handover. Call out charges will be billed directly to the building operator.
- 03.12.6 The PPM scope shall include but not be restricted to the following;
- Maintenance of Heating Systems including overseeing annual plant maintenance, re-adjusting water balancing as required, removing air from systems / venting radiators, cleaning dirt/ air separator filters etc.
  - Maintenance of Ventilation Systems including replacement of both panel and bag filters to Air Handling Units, checking/ replacing fan belts as required, checking fan operation, checking dampers are open etc.
  - Maintenance of Water and Wastes systems including re-adjustment of pressures as required, cleaning/ replacing of filters etc.
  - Maintenance of natural gas Systems.
  - Maintenance of Fire Fighting Installations including overseeing checks to extinguishers.
  - The costs of providing all maintenance including where necessary works required to be undertaken by specialists or third parties is deemed included in the Tender.
- 03.12.7 The following maintenance elements are deemed excluded from the requirements of this specification, however this may be undertaken at additional cost and if agreed between the Contractor and building operator;
- Portable Appliance Testing.
  - Provision of Consumables (over and above those listed as spares in the specification).
  - Maintenance of client provided equipment.
- 03.12.8 Following each PPM visit (including those of any specialist) the Contractor shall issue a report to be signed by a representative of the building operator, before being submitted to the Engineer. The report shall include brief details of the visit, including, who attended site, the works undertaken, the time duration etc.
- The report shall identify the condition of plant and equipment, list the maintenance undertaken and highlight any issue that may require further

remedial action but was not possible to address within the context of the PPM visit.

- 03.12.9 In the event of the Contractor failing to carry out the PPM within reasonable time frames, the Contractor will be advised that these works will be undertaken by others appointed by the client and all associated costs will be deducted from retention or other monies outstanding.

## 03.13 Defects Liability

- 03.13.1 During the Maintenance period any defect developed in the Mechanical Services Installations during this period shall be rectified and made good at the Contractor's own expense. Exceptions will only be made where it is evident that the cause can be seen to be outside the Contractors control.
- The term defect in shall be interpreted as:
  - 'any item of plant, equipment or component thereof, accessory or fitting that shall be found defective, show signs of mechanical or electrical weakness or undue wear in consequence of faulty design, workmanship or material'.
- 03.13.2 In the event of the Contractor refusing to rectify such defects within a reasonable period, the Engineers will have the works carried out by others, and any charges arising there from shall be at the expense of the Contractor and deducted from retention monies.

## 03.14 Controls Devices

- 03.14.1 The Mechanical Contractor shall be responsible for installing all control devices to both pipework and ductwork systems.
- 03.14.2 The Mechanical Contractor shall install controls devices immediately prior to commissioning stage. Sensor pockets only shall be installed at first/second fix stages to enable pressure testing etc. to be completed.

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## 12 Outline Description

- 12.1.1 The Heating Pipework Installations shall comprise the following welded steel pipework circuits supplying LPHW throughout the project.
- 12.1.2 The Mechanical Contractor shall be responsible for the supply and installation, of all pipework and plant as detailed as indicated on IN2 Engineering Design Partnership drawings.
- 12.1.3 All flow meters to be provided free issue from BMS controls contractor and installed by mechanical contractor.
- 12.1.4 All motorised valves to be provided free issue from BMS controls contractor (unless otherwise indicated) and installed by mechanical contractor.
- 12.1.5 The Mechanical Contractor shall carefully read the notes on the drawings and include for all associated costs in his tender.

### 12.1 Standards

- 12.1.1 The chiller installation shall comply with the requirements of the following standards, regulations and directives.
  - BS 2971: 1991: Specification for class 11 arc welding of carbon steel pipework for carrying fluids (AMD 9773)
  - BS1821: 1982: Arc welding of austenitic stainless steel pipework for carrying fluids (AMD 5577) (AMD 9767)
  - HVCA TR/5 Welding of Carbon Steel Pipework: Code of Practice
  - HVCA TR/20 Installation and Testing of Pipework System Parts 1 - 10
  - IS EN 1264-4: 2001: Floor heating - Systems and components - Installation
  - BSRIA Guide Pre-commission Cleaning of Pipework Systems (2nd Edition)
  - BS 5970: 2001: Code of practice for thermal insulation of pipework and equipment in the temperature range of -100°C to +870°C.
  - BS 6683:1985: Guide to installation and use of valves (AMD 6604)
  - BS 6129-1: 1981 The selection and application of bellows expansion joints for use in pressure systems
  - BS 759-1: 1984: Valves, gauges and other safety fittings for application to boilers and to piping installations for and in connection with boilers. Specification for valves, mountings and fittings (AMD 5890)
  - BRE FB72: 2014: A Technical Guide to District Heating
  - EN 253:2009 Pre-insulated bonded pipe systems for underground hot -water networks. Pipe assembly of steel service pipe, polyurethane thermal insulation and outer casing of polyethylen

- EN 448:2009 Pre-insulated bonded pipe systems for underground hot water networks – Fitting assemblies of steel service pipes, polyurethane thermal insulation and outer casing of polyethylene.
- EN 488:2011 Pre-insulated bonded pipe systems for underground hot water networks – Steel valve assembly for steel service pipes, polyurethane thermal insulation and outer casing of polyethylene.
- EN 489:2009 Pre-insulated bonded pipe systems for underground hot water networks – Joint assembly for steel service pipes, polyurethane thermal insulation and outer casing of polyethylene.
- BS EN 14419:2009 District heating pipes – Pre-insulated bonded pipe systems for directly buried hot water networks – Surveillance systems.
- BS EN 15698-1:2009 District heating pipes – Pre-insulated bonded twin pipe systems for directly buried hot water networks – Twin pipe assembly of steel service pipe, polyurethane thermal insulation and outer casing of polyethylene.
- BS EN 13941:2009 Design and installation of pre-insulated bonded pipe systems for district heating.
- BS 1710 :2014 Specification for identification of pipelines and services

## 12.2 Equipment - Pipework

- 12.2.1 All Heating and Chilled Water pipework up to Ø150mm shall be fabricated from medium quality mild steel tubing to BS 1387, all Heating and Chilled Water pipework equal to or greater than Ø150mm shall be fabricated from carbon steel tubing to BS EN 10216.
- 12.2.2 All pipework shall be new, clean, free from defects, of even bore throughout and delivered to site with the manufacturer's protective coating undamaged. All pipework shall be stored clear of the ground and shall be suitably protected from the weather.
- 12.2.3 All pipework shall be welded throughout. Particular care shall be taken to protect finishes when welding. All pipework in floor ducts and plantrooms shall be painted with red oxide by the Mechanical Contractor prior to insulation and cladding. No compression fittings shall be used. Particular care shall be taken to protect finishes when welding. All pipework in floor ducts and plantrooms shall be painted with red oxide by the Mechanical Contractor prior to insulation and cladding.
- 12.2.4 Electrodes, filler wires and rods should be stored and handled in accordance with the manufacturer's instructions.
- 12.2.5 For welding joints a flux having a borax base shall be used in a paste which shall be evenly and thoroughly distributed over the surfaces to be jointed. A powder flux, if used, shall be wetted to form a paste before jointing.
- 12.2.6 The contractor shall ensure all gaskets selected are suitable for the jointed materials, system temperature and service.
- 12.2.7 Pipework Insulation**
- 12.2.8 All concealed Heating and Chilled Water pipework, valves and fittings shall be insulated with preformed rigid glass fibre sections containing water repellent additives. The sections shall be supplied with a factory applied facing of reinforced aluminium foil incorporating self-adhesive overlap for fixing.
- 12.2.9 All concealed heating pipework, valves and fittings shall be insulated with preformed rigid glass fibre sections containing water repellent additives. The sections shall be supplied with a factory applied facing of reinforced aluminium foil incorporating self-adhesive overlap for fixing.
- 12.2.10 The mineral wool insulation shall be non-combustible. The aluminium foil covering shall be rated 'Class O' in accordance with the Building Regulations Part B.
- 12.2.11 All pipework shall be installed complete with insulation achieving a thermal conductivity of 0.025W/m.K to comply with BS 5422. The aluminium foil covering shall achieve a maximum vapour permeance of 0.00024g/s.MN.
- 12.2.12 All insulation fixing shall 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 75mm wide aluminium tape shall be used to maintain integrity of the vapour barrier.
- 12.2.13 All pipework installed both within plant areas and externally shall be clad. Cladding shall be not less than 0.8mm aluminium sheeting or stucco embossed profile cladding.

12.2.14 All valves shall be insulated using 'valve blankets' to enable frequent access. All covers shall be designed to enclose the entire valve body including bonnet flange, mating flanges and overlap adjacent line insulation by a minimum of 50mm. Covers wherever practical will be constructed in one piece. All covers above 500mm x 500mm shall have blanket quilting pins installed at sufficient centres to prevent the insulation from shafting or pulling away from the outer jacket. All covers to be of aa sewn construction. All flaps to be installed in a manner which provides suitable water shedding. Each individual cover shall have an identification tag. All Valve Blankets shall comply with BS 476, Part 7, 1971, and Part 6, 1989: Class 'A' and Class 'O'. All blankets shall have the following characteristics:

- Temperature Range: 10 degrees C to 230 degrees C.
- Inner Face: 430g single sided silicone. (Insulation to achieve a thermal conductivity of 0.043W/m.K. The aluminium foil covering shall achieve a maximum vapour permeance of 0.00024g/s.MN.)
- Outer Face: 430g single sided silicone.
- Fasteners: Velcro type hooks and loop flaps, 25mm D-rings complete with clinch straps are optional.
- Draw Cord: 4mm spun fiberglass cord.
- Quilts: 100mm Stainless Steel.
- Thread: PTFE coated glass fibre thread.
- ID Label: Laminated

12.2.15 Heating pipework insulation thicknesses shall conform to the tables below:

| Insulation Thickness |                      |                          |                                                  |
|----------------------|----------------------|--------------------------|--------------------------------------------------|
| Nominal pipe bore    | LTHW Heating Systems | Chilled Water Systems    |                                                  |
|                      |                      | Pipework within building | Pipework in floor trenches, ducts and plantrooms |
| (mm)                 | (mm)                 | (mm)                     | (mm)                                             |
| 15                   | 25                   | 38                       | 50                                               |
| 20                   | 25                   | 38                       | 50                                               |
| 25                   | 38                   | 38                       | 50                                               |
| 32                   | 38                   | 38                       | 50                                               |
| 40                   | 38                   | 38                       | 50                                               |
| 50                   | 38                   | 63                       | 75                                               |
| 65                   | 38                   | 63                       | 75                                               |
| 80                   | 38                   | 63                       | 75                                               |
| 100                  | 38                   | 63                       | 100                                              |
| 125                  | 38                   | 75                       | 100                                              |
| 150                  | 50                   | 75                       | 100                                              |
| 200                  | 50                   | 75                       | 100                                              |
| 250                  | 50                   | 75                       | 114                                              |
| Above 250            | 50                   | 100                      | 114                                              |

### **12.2.16** Fittings

- 12.2.17 All strainers 50mm diameter and under shall be of the bronze "Y" type pattern to PN32 with 40 mesh (400 micron) stainless steel screen. All strainers shall have a core of ceramic magnets inside the screen.
- 12.2.18 All strainers 65mm diameter and above shall be of the flanged cast iron "Y" type pattern to PN 16 with 20 mesh (750 micron) stainless steel screen. All strainers shall have a core of ceramic magnets inside the screen.
- 12.2.19 All unions shall be of the best quality gunmetal, cone seated type.
- 12.2.20 All temperature gauges shall be of the vapour pressure type with brass case, straight stem, 100mm diameter dial with chrome plated bezel and complete with 100mm pocket. Temperature gauge range shall be 0°C -120°C with an accuracy of +/- 1.5% of the effective range.
- 12.2.21 All pressure gauges to be of the vapour pressure type with 100mm diam. dial. Pressure gauge range shall be to suit the application with the normal operating pressure falling towards the mid-point of the range with an accuracy of +/- 1% of the effective range.

### **12.2.22** Valves

- 12.2.23 All safety valves shall be bronze or gunmetal manufactured in accordance with BS 6759: 1995. Safety valves shall be temperature rated to operate from -10°C to 180°C. All safety valves shall be clearly marked with manufacturer's name, material designation, pressure rating, size and directional flow.
- 12.2.24 Isolating Valves
- All isolating valves 50mm diameter and under shall be bronze or gunmetal gate valves manufactured in accordance with BS5154 PN20. Isolating valves shall be temperature rated to operate from -10°C to 180°C. Isolating valves shall be Handwheel or Lockshield pattern as specified on IN2 Engineering Design Partnership Drawings. All valves to be fitted with female sockets for bronze welding. All valves shall be clearly marked with manufacturer's name, material designation, pressure rating, size and directional flow.
  - All isolating valves 65mm diameter and above shall be butterfly valves of the flanged cast iron type to BS 5155. Isolating valves shall be temperature rated to operate from -10°C to 120°C. All valves shall be clearly marked with manufacturer's name, material designation, pressure rating, size and directional flow.
- 12.2.25 Double Regulating Valves
- All double regulating valves 50mm diameter and under shall be Y-pattern globe valves of the bronze type to PN25. Double regulating valves shall be temperature rated to operate from -10°C to 120°C. All valves to be fitted with female sockets for bronze welding. All valves shall be clearly marked with manufacturer's name, material designation, pressure rating, size and directional flow.
  - All double regulating valves 65mm diameter and above shall be Y-pattern globe valves of the flanged cast iron type to BS 7350 PN16. Double regulating valves shall be temperature rated to operate from -10°C to 180°C. All valves shall be clearly



marked with manufacturer's name, material designation, pressure rating, size and directional flow.

- All fixed orifice double regulating valves 50mm diameter and under shall be Y-pattern globe valves with orifice insert and integral test points of the bronze type to PN25. Fixed orifice double regulating valves shall be temperature rated to operate from -10°C to 120°C. All valves to be fitted with female sockets for bronze welding. All valves shall be clearly marked with manufacturer's name, material designation, pressure rating, size and directional flow.
- All fixed orifice double regulating valves 65mm diameter and above shall be Y-pattern globe valves of the flanged cast iron type to BS 7350 PN16 complete with stainless steel orifice plate with integral test points and true square upstream edge. Fixed orifice double regulating valves shall be temperature rated to operate from -10°C to 120°C. All valves shall be clearly marked with manufacturer's name, material designation, pressure rating, size and directional flow.

#### 12.2.26 Check Valves

- All check valves 50mm diameter and under shall be bronze manufactured in accordance with BS5154 PN20. Check valves shall be temperature rated to operate from -10°C to 180°C. Check valves shall be swing or lift type as required by installed position on IN2 Engineering Design Partnership Drawings. All valves to be fitted with female sockets for bronze welding. All valves shall be clearly marked with manufacturer's name, material designation, pressure rating, size and directional flow.
- All check valves 65mm diameter and above shall be flanged cast iron swing type to PN16. Check valves shall be temperature rated to operate from -10°C to 180°C. Swing check valves shall be installed in a horizontal position or where this is not possible in the vertical so that the valve will close under zero-flow conditions. All valves shall be clearly marked with manufacturer's name, material designation, pressure rating, size and directional flow.

#### 12.2.27 Differential pressure Control Valves (DPCV)

- The contractor shall make contact with valve manufacturer to review DPCV valve design strategy. The contractor shall engage the manufacturer to determine the valve sizing schedules (inc flow rates, pressure drops etc.) and determine appropriate valve positions within the system. The contractor shall provide manufacturers valve design (inc any necessary pipework alterations) to the design team for comment, prior to placing order.
- The Contractor shall install in positions indicated on the drawings issued, a differential pressure control arrangement. The valve arrangement will comprise of a differential pressure control valve (DPCV), installed on the return pipe (unless otherwise stated by manufacturer), connected via the capillary supplied to a commissioning valve positioned on the flow. The commissioning valve shall be selected to provide a measurement signal across the metering station for flow measurement of between 1.0 and 4.7Kpa. The DPCV shall be selected to provide an optimum pressure drop across the unit of between 3&10kPa. The DPCV shall control the downstream sub circuit pressure as indicated in the valve selection schedule. An isolating valve shall be provided adjacent to and downstream of the DPCV on the return pipe to enable system isolation and maintenance. A T- piece

measuring adaptor shall be installed on to the commissioning valve. Please refer to manufacturer for typical installation detail.

- Where DPCV's are to be used in conjunction with TRV's, the maximum downstream sub circuit pressure loss being controlled by a DPCV arrangement should not exceed 30 kPa.
- All DPCV sets shall be capable of maintaining a constant pressure across the circuit with varying flows/pressures in the main system. All differential pressure regulator valves shall be suitable for a maximum working pressure of 10bar and temperature range of -10°C to 120°C. The valve body, bonnet and regulator shall be manufactured from bronze. The valve disc and stem shall be manufactured from brass and shall be resistant to dezincification. The valve shall be capable of acting as an isolation valve. All DPCV's shall be supplied / installed complete with corresponding control valve, capillary (as detailed above) and all other necessary ancillaries.
- All DPCV's sets shall be complete with graduated indicator. All DPCV's shall be capable of being locked in position to prevent tampering once commissioning has been carried out.

#### 12.2.28 Pressure Independent 2-port Control Valves (PICV)

- The contractor shall make contact with valve manufacturer to review DPCV valve design strategy. The contractor shall engage the manufacturer to determine the valve sizing schedules (inc flow rates, pressure drops etc.) and determine appropriate valve positions within the system. The contractor shall provide manufacturers valve design (inc any necessary pipework alterations) to the design team for comment, prior to placing order.
- The Contractor shall install in positions indicated on the drawings issued, a pressure independent 2 port control valve arrangement. The valve set will comprise of a PICV and a flushing bypass arrangement. The valve shall be installed with the flow direction arrow positioned to ensure correct water flow through the valve. To ensure successful commissioning of the system the PICV shall be selected to provide a minimum pressure drop across the unit as indicated in the valve selection schedule. The valve shall have the following functions:
  - 2 Port Control with actuator (please refer to control strategy for particular actuator specification).
  - Automatic (lockable) flow regulator with external, visible flow indicator markings for hydronic balancing.
  - Internal differential pressure control arrangement to maintain flow control and valve authority.
  - Pressure measurement test points (including necessary adaptor / transition pieces).
  - A fixed orifice measuring station shall be installed on all circuits served from PICV's, to allow for verification of commissioned flow rates.

#### 12.2.29 Combined low loss headers, dirt and air separators

- All combined low loss headers, dirt and air separators shall be flanged to PN16 for sizes 50mm and above and shall incorporate automatic air vent, air chamber, air

release valve for system fill, collection chamber and quarter turn ball valve at the lowest point to allow dirt removal whilst the system is operational.

- The combined low loss headers, dirt and air separators shall be installed vertically, against plant room wall.
- The combined low loss headers, dirt and air separators shall come complete with drain cock. The drain shall be piped in Ø22mm copper pipe to floor level with plant room.
- All combined low loss headers, dirt and air separators shall be suitable for a maximum working flow temperature of 90°C and pressure of 10 Bar.
- All units shall have a mild steel housing fitted with a non-clogging cluster manufactured from steel tube and copper wire.
- The air release system shall comprise of a solid polypropylene float not mechanically coupled to the air release valve. The valve shall be spring loaded so providing positive shut off.
- The pressure drop across the combined unit shall remain constant regardless of the amount of dirt trapped.
- All combined dirt and air separators shall:
  - Remove not only free but also dissolved gases released in the form of micro- bubbles.
  - Remove all particles of dirt heavier than water, down to 10 micron and less.

## 12.3 Construction Products Regulations

- 12.3.1 All products, materials and equipment used on this project shall comply with the Construction Products Regulations. All Construction Products covered by harmonised European Standards must carry a CE mark. The EU Construction Products Regulation (No. 305/2011 - CPR) shall apply in full to all products and materials proposed for use on this project.
- All products where applicable must comply with relevant Harmonised European Standards (hENs)
- 12.3.2 All products must be provided with a Declaration of Performance (DoP). The DoP must be provided by the manufacturers and must provide information relating to the characteristics of the product and confirm the conformity of the construction product with the declared performance. The CE mark attributed to the product must follow the DoP.
- 12.3.3 All technical submittals for products and equipment proposed by the Contractor must include all relevant DoP's, and must in the first instance be verified by the Contractor before submitting to the Employers Representative or Engineer. The Contractor must verify that the products being proposed do comply with the DoP and are suitable for their intended use in construction works and suitable for the application intended. The Contractor must also refer to National Standards to ensure that any National minimum standards for specific intended uses of the product in Ireland are complied with. Where such verifications and a DoP has not been provided as part of the technical submittal, the submittal will be deemed invalid and will not be considered. No claims for time lost, or cost increases owing to a potential change in the products or materials shall be considered by the Engineer or Employers Representative as a result.
- 12.3.4 The Contractor as part of his "Ancillary Certifiers" role under Building Control Amendment Regulations (BCAR), shall maintain a record of all DoP's and shall include same as part of his Inspection Plan records and reports.
- 12.3.5 The manufacturer's must fully comply with their obligations under the Construction Product Regulations, and shall if requested provide any additional, or supplementary information as may be requested by the Engineer or Employers Representative as may be considered necessary. In the event of such information not being forthcoming within a timely manner the Contractors proposal shall be rejected. No claims for time lost, or cost increases owing to a potential change in the products or materials shall be considered by the Engineer or Employers Representative as a result.
- 12.3.6 The Contractor must ensure compliance with Building Regulations and as such, all works must be carried out using proper materials that are fit for the use for which they are intended and for the conditions in which they are to be used.
- 12.3.7 The Contractor shall refer to the details within the Construction Products Regulation (CPR), and all annex's therein and shall ensure that all related elements are fully satisfied.

## 12.4 Samples & Technical Submittals

- 12.4.1 In advance of orders being placed for any equipment the contractor shall submit a full technical submittal including specific details of equipment dimensions, operational data, rated power, controls and wiring diagrams, materials specification.
- 12.4.2 The contractor shall include for the provision of 1 No. sample of each item as detailed. Samples to be erected and displayed for design team approval.
- 12.4.3 The contractor shall be responsible for determining quantities from IN2 Engineering Design Partnership drawings and specifications.
- 12.4.4 The contractor shall liaise with the various specialist suppliers to ensure that all necessary fixings kits, supports, connections, etc. are included.
- 12.4.5 The contractor shall refer to IN2 Engineering Mechanical Specification, Section M00 General Specification, part 00.4 "Production of Information - Procurement Details".
- 12.4.6 The contractor shall refer to IN2 Engineering Mechanical Contract Particulars, Section 2.5 Submittal of Alternatives & Section 2.7 Value Engineering.
- 12.4.7 All technical submittals shall be issued in the following format.
- A full index of items, date & revision number of submittal shall be included on the submittal title page.
  - All manufacturers / Suppliers schedules shall refer to IN2 item references.
  - Sections of IN2 specification relevant to the submittal, shall be returned from the manufacturers / Suppliers with each line item labelled by supplier / manufacturer as follows:
  - "Manufacturer / Supplier Initial" & "Compliant" or "Non-Compliant".
  - Should a line item prove non-compliant to spec, the manufacturer / supplier shall include details of proposed alternative.
  - Expected lead-in times shall be included for all items.
  - Where applicable contractor shall propose date for reviewing / approving samples on site.
  - Individual submittals shall be limited to related items of plant/equipment; to prevent re-submission of part-submittals under the same reference, should some items be rejected.

## 12.5 Approved Manufacturers and Vendors

- 12.5.1 All equipment and ancillary components must be selected from the same manufacturers range.
- 12.5.2 Alternative products / systems will be considered if the contractor can demonstrate that the proposed alternative is equivalent to that specified in all of the following criteria: dimensions, performance, durability, materials, workmanship, quality, service life and aesthetics. Such alternative products / systems will be included in the works only after Employer Representative determination and written Employer Representative 'approval', which may be refused

## 12.6 Installation

12.6.1 The arrangement and size of all heating pipework and fittings as required shall be as shown as indicated on IN2 Engineering Design Partnership M100 series drawings and where necessary, as agreed with the Engineers on site.

12.6.2 All final electrical connections (where applicable) to be made by supplier at expense of mechanical contractor. All connections to be certified as Sub-System using separate Sub-System Completion Certificate. These certificates together with the relevant Test Record Sheets must be submitted to the Project Supervisor for inclusion in Project Safety Manual. Details such as Sub-System Completion Certificate numbers and Sub-System description should be recorded in the comment section of the certificate covering the entire installation.

### 12.6.3 Pipework

12.6.4 All mild steel pipework installed at high level shall be supported by means of clips, supports or hangers at the following centres:

| Nominal Diameter of Pipe (mm) | Support Interval (m) |            |
|-------------------------------|----------------------|------------|
|                               | Vertical             | Horizontal |
| 15                            | 2.4                  | 1.2        |
| 20                            | 2.4                  | 2.1        |
| 25                            | 3.0                  | 2.4        |
| 32                            | 3.0                  | 2.0        |
| 40                            | 4.5                  | 3.0        |
| 50                            | 6.0                  | 3.6        |
| 65                            | 6.0                  | 4.5        |
| 80                            | 6.0                  | 4.5        |
| 100                           | 6.0                  | 6.0        |
| 125                           | 6.0                  | 6.0        |
| 150                           | 6.0                  | 6.0        |

- 12.6.5 All 15mm and 20mm diameter pipework installed at low level shall be supported at 1,200mm centres, with all other sizes supported at 1,800mm centres.
- 12.6.6 All supports for steel pipes and fittings shall be ferrous.
- 12.6.7 It shall be the responsibility of the Contractor to ensure that all supports are adequate, firmly and truly fixed and that they do not promote vibration.
- 12.6.8 Brackets or supports shall be set out so that they do not obstruct the access to valves, flanges or other fittings requiring maintenance.
- 12.6.9 Where pipes pass through walls, floors, footings and waterproof membranes, the Contractor shall provide sleeves. Sleeves shall be built in by the Main Contractor but the Contractor shall be responsible for the correct installation. Sleeves shall be provided for installation at the time required by the Main Contractor.
- 12.6.10 The inside diameter of the sleeves shall not be less than 15mm larger than outside diameter of the pipe, except where pipes pass through the bearing walls or footings where sleeves shall be 100mm larger than the outside diameter of the pipe. Sleeves shall protrude not less than 1mm and not more than 3mm proud of the finished surface. Sleeves shall be of pipe cuttings properly reamed, cleaned and trimmed perpendicular to bore. Where pipes pass through visible walls, floors and ceilings, they shall be fitted with chromium plates.
- 12.6.11 Sleeves in bearing walls or footings shall be cast iron pipe. Sleeves in walls, floors, ceilings and partitions shall be of the same metal as the pipe. Sleeves of other materials will be permitted provided they are inert and approved by the Engineer.
- 12.6.12 Wherever possible, advantage is to be taken of changes in direction to the pipework to absorb expansion. Where expansion loops are shown, they are to be fire set brazed short radius bends, cold sprung to a minimum of 25mm prior to fixing. Expansion loops are to be fitted with loose sliding saddles at their centres to prevent lifting during expansion.
- 12.6.13 Anchors shall be fitted where shown. They shall generally be fabricated from 100mm x 50mm channel iron. Saddles, fabricated from flattened 28mm diameter pipe, shall be bolted to the channels.
- 12.6.14 All pipework shall be installed with adequate space provision for the removal for repair, maintenance or replacement of plant and equipment. All plant and equipment shall be fitted with isolation valves to all connections to facilitate the isolation and removal of plant.
- 12.6.15 Were the contractor intends to run pipework exposed or surface mounted, the contractor submit proposal for design team approval.
- 12.6.16 Were pipework serving radiator is called up to be run surface mounted. The pipework shall drop behind the radiator (along centre line) to connections at base.
- 12.6.17 Direct buried pipework shall be laid on 100 mm fine sand bedding with 200 mm fine sand over, back filled with existing sub-soil with warning tape at 300 mm below finished ground level. Total installed cover to pipework shall be a minimum of 600mm. Surface made good to Architects detail.

#### **12.6.18 Fittings**

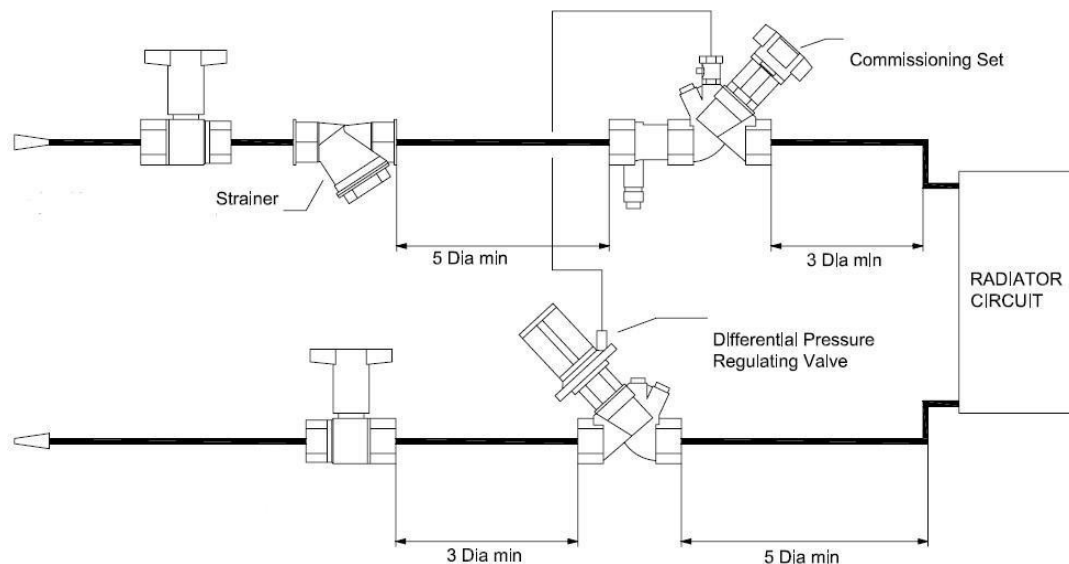
- 12.6.19 All fittings and instrumentation shall be installed so that they are accessible for inspection, lubrication and maintenance and are fully operable.
- 12.6.20 All strainers shall be installed in the horizontal position where possible. Where strainers must be located on vertical pipework circuits, they shall be installed on the downward flow pipe of the circuit.
- 12.6.21 Manual air vents shall be provided to all high points of the system or wherever air may be trapped. Air vents shall be readily accessible and drained to nearest outlet in copper.
- 12.6.22 Temperature and pressure gauges shall be installed in a visible and accessible position.
- 12.6.23 Temperature and pressure gauges shall be installed in self draining stainless steel pockets.
- 12.6.24 Binder test points shall be provided to each side of all plant and equipment including, boilers, heat exchangers, heating and cooling coils, pumps, control valves etc. All binder points shall be self-sealing and fitted with a screwed cap.
- 12.6.25 All flow meters to be provided free from BMS controls contractor (Unless otherwise stated) and installed by mechanical contractor.

#### **12.6.26 Valves**

- 12.6.27 Safety valves shall be fitted to all hot water boilers, Calorifiers and other heat generating plant serving the heating system. Safety valves shall be mounted vertically and fitted directly to the system without any intervening isolation device. The pipeline connection shall be the full bore of the safety valve. Discharge piping shall be properly supported and impose no significant load on the safety valve and have an unrestricted drain pipe with a visible discharge point, positioned where injury to persons cannot occur.
- 12.6.28 Safety valve discharge piping shall be of a bore not less than that of the outlet of the safety valve and be as short as possible to present the least resistance to flow. Safety valve set pressure shall be 10% (or minimum of 0.7 bar) above maximum working pressure, with a minimum setting of 1.3 bar (to prevent unnecessary lifting of the safety valve). In no case should it exceed the boiler or Calorifier design pressure.
- 12.6.29 All valves shall be line size unless otherwise indicated and shall be regulated, packed and glands adjusted on completion of works prior to system performance testing. The type and appearance of all valves shall be consistent throughout the installation.
- 12.6.30 Isolating valves shall be installed at all branches from the main pipelines and risers, at all equipment and apparatus items to both flow and return connections.
- 12.6.31 Commissioning Set manufacturing tolerances shall ensure a main flow of water within +/-5% of a given pressure differential measurement on a manometer. Commissioning Sets shall be selected against their relative flow rate to ensure that the minimum pressure signal as recommended by the valve manufacturer is obtained to ensure accurate readings.
- 12.6.32 Drain valves shall be installed at all low undrainable parts of the system.



12.6.33 Please refer to drawing for typical differential pressure regulator (DPCV) set installation detail.



- 12.6.34 Contractor to engage dynamic control valve (i.e. DPCV's, PICV's, TRV's etc.) manufacturer to attend 1No. site meeting prior to installation of valves to discuss proper installation / commissioning procedures, to ensure contractor is fully acquainted with system.
- 12.6.35 Contractor to engage dynamic control valve (i.e. DPCV's, PICV's, TRV's etc.) manufacturer to carry out 1No. site review during installation of valves to ensure manufacturers requirements/standards are being met.
- 12.6.36 Contractor to engage dynamic control valve (i.e. DPCV's, PICV's, TRV's etc.) manufacturer to carry out 1No. site review during commissioning of valves to ensure system is being properly commissioned in accordance with manufacturers recommendations.
- 12.6.37 All motorised valves to be provided free issue from BMS controls contractor (Unless otherwise stated or Unless motorised valves are integral to Dynamic control valve system) and installed by mechanical contractor.

### **12.6.38    Insulation**

- 12.6.39    Pipework shall remain un-insulated until satisfactory completion of all hydraulic tests.
- 12.6.40    The brackets and roller supports on all insulated pipework shall support the pipework outside the insulation and a suitable spacer piece and spreader plate shall be provided at each support point.
- 12.6.41    All heating pipework in habitable spaces and surface mounted, exposed at skirting level, or dropping to skirting level shall remain un-insulated.
- 12.6.42    Heating pipework within all plant room areas shall be clad for protection of insulation.
- 12.6.43    All valves, flanges and accessories within all plant room areas and fittings in all areas shall be insulated to the same thickness specified for the pipeline and provided with snap fastening, readily removable, type Aluzinc boxes.
- 12.6.44    Upon completion of all insulation works the mechanical contractor shall provide identifying markers and laminated valve identity tags to each and every service, whether insulated or not, in accordance with C.I.B.S.E. Codes of Practice. Identity tag numbers shall be unique to the designated service and cross-referenced for function and use etc. to local and permanently fixed laminated valve schedules and associated diagrammatic pipeline layouts. The precise locations for same shall be agreed with the consulting engineers prior to installation.

### **12.6.45    Combined low loss headers, dirt and air separators**

- 12.6.46    All combined low loss headers, dirt and air separators shall be installed so that they are accessible for inspection, lubrication and maintenance and are fully operable.
- 12.6.47    All combined low loss headers, dirt and air separators shall be installed to manufacturer's recommendations.
- 12.6.48    All combined low loss headers, dirt and air separators shall come complete with proprietary support system, installed to manufacturer's recommendations.
- 12.6.49    All air vents, integral to combined low loss headers, dirt and air separators shall be readily accessible and drained to nearest outlet in copper.
- 12.6.50    Temperature and pressure gauges shall be installed in a visible and accessible position.
- 12.6.51    Temperature and pressure gauges shall be installed in self draining stainless steel pockets.
- 12.6.52    Binder test points shall be provided to each side of all combined low loss headers, dirt and air separators including. All binder points shall be self-sealing and fitted with a screwed cap.

## **12.7    Testing & Commissioning**

- 12.7.1    All heating pipework shall be tested to 700 kPa and held droptight at this pressure for a duration of 1 hour. The tests shall be only considered valid if witnessed by the Engineer or Client representative and certified accordingly.
- 12.7.2    All heating pipework circuits shall be proportionately balanced and set to design flowrates.
- 12.7.3    On completion of the appropriate tests, to the approval of the Engineers, all pipework shall be cleaned and wire brushed of all grease, dirt metal cuttings, sludge, etc., which may have accumulated.
- 12.7.4    The Contractor shall submit sample bottles of heating systems for the Engineer's approval. The samples will be submitted after completion of system flushing and be taken from an agreed position.

- 12.7.5 Contractor to engage dynamic control valve (i.e. DPCV's, PICV's, TRV's etc.) manufacturer to attend 1No. site meeting prior to installation of valves to discuss proper installation / commissioning procedures, to ensure contractor is fully acquainted with system.
- 12.7.6 Contractor to engage dynamic control valve (i.e. DPCV's, PICV's, TRV's etc.) manufacturer to carry out 1No. site review during installation of valves to ensure manufacturers requirements/standards are being met.
- 12.7.7 Contractor to engage dynamic control valve (i.e. DPCV's, PICV's, TRV's etc.) manufacturer to carry out 1No. site review during commissioning of valves to ensure system is being properly commissioned in accordance with manufacturers recommendations.

## 12.8 Labelling

- 12.8.1 All pipework shall be identified by means of self-adhesive coloured bands at intervals not greater than 3m, at valve or expansion joint positions, at inlet and exit positions to ducts or buildings and at either side of walls or floors. The identification shall be in accordance with BS 1710: 2014 with colours to BS 4800: 1989.
- 12.8.2 The name of the service should be indicated on an identifying worded band located in a visible position, together with an arrow indicating direction of flow. Flow and return mains should have the letter F or R added to the identifying name.
- 12.8.3 Suppliers shall be requested to label all equipment and packages with identification numbers, to ensure items can be correctly identified.
- 12.8.4 All valves and fittings shall be individually numbered and identified by means of 'traffo labels' securely fixed to the valve or fitting. A valve chart suitably protected with a permanent finish, showing the positions and numbering of the valves should be fixed in an agreed position.

## 12.9 Documentation

- 12.9.1 Upon project completion the contractor shall provide complete Operation and Maintenance instructions with "As installed" drawings.
- 12.9.2 The contractor shall provide the following documentation for all heating plant installations;
- Manufacturer's test conformance sheets.
  - Complete pressure test results indicating:
    - Date of test.
    - Test pressure.
    - Duration of test.
  - Signatures of the contractors witness and engineers' representative witness.
  - Complete commissioning results indicating:
    - Date of commissioning
    - Design flow rates and pressure drops
    - Commissioned flow rates and pressure drops

## 12.10 Extra Materials

- 12.10.1 At practical completion and in addition to handover documentation the following spare parts and items of equipment shall be provided for use by the client;
- 1No. Specialist service tool to facilitate filling and draining via the Lockshield valves
  - 5 No. Handwheel valves.

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## 15.1 Outline Description

- 15.1.1 The Contractor shall be responsible for the supply, installation & commissioning, of all chiller plant as detailed on IN2 Engineering Design Partnership drawings.
- Appendix A : Schedule of Chillers
- 15.1.2 The Mechanical Contractor shall carefully read the notes on the drawings and include for all associated costs in his tender.
- 15.1.3 All equipment and ancillary components must be selected from the same manufacturers range.
- 15.1.4 The Chiller plant supplying a common Chilled Water header; header at supply and return temperatures 7/12°C (TBC).
- 15.1.5 The proposed chiller to come with integral on-board pumps in a duty/standby arrangement.
- 15.1.6 Existing BMS integration shall be maintained and updated as required to allow monitoring, alarm monitoring & sequencing of the new chiller installation,
- 15.1.7 The Mechanical Contractor shall be responsible for the Design, Selection and installation of the complete support & Bracketry systems (inc Anit-Vib Mounts, plinths & proprietary support systems) including anchor systems and metal framing supports etc. The Contractor shall be responsible for determining the appropriate components, materials and methods of installation based on the fully loaded capacities +50% of proposed systems / equipment and the structure from which the systems / equipment is to be mounted. All support system hangers shall be spaced at intervals of not greater than those laid out in the services specific section of the specification and when fully loaded shall not deflect between supports. The Contractor shall consider all requirements when making selections and shall reduce spacing of supports as required but shall not increase spacings. Additional supports are to be provided at intersections and any changes in direction.
- 15.1.8 The Contractor shall provide details of all anchors and fixings for review by the Structural Engineers and shall allow for "pull-out" testing to verify selections based on site conditions.

## 15.2 Standards

- 15.2.1 The chiller installation shall comply with the requirements of the following standards, regulations and directives.

- BS 7074-3: 1989: Application, selection and installation of expansion vessels and ancillary equipment for sealed water systems. Part 3. Code of practice for chilled and condenser systems.
- BS EN 14511-1:2018 Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors. Terms and definitions
- 2014/68/EU European Directive for Pressurised Equipment.

## 15.3 Equipment

- 15.3.1 The Contractor shall be responsible for the supply, installation, commissioning of 1 no. Air Cooled Outdoor Chiller with Integrated Hydronic Modules and ancillary components as indicated on IN2 Engineering Design Partnership M1100 series drawings.
- 15.3.2 The unit casing and all structural members and rails shall be fabricated from continuous galvanised U steel beam, covered by three protection layers. Exterior casing shall be galvanized steel and coated with an oven baked polyester paint finish to RAL 7035. The cabinet shall be capable of withstanding 500 hour salt spray test in accordance with ASTM B117 standard.
- 15.3.3 Chiller plant shall be selected to ensure minimum stated outputs are maintained at a glycol concentration of 30%.
- 15.3.4 Condenser fans shall be 11 blade shrouded axial type arranged for vertical air discharge and individually driven by direct drive fan motors. Each fan shall be protected by a heavy gauge fan guard. Condenser fan motors shall be three-phase, direct drive, 950 RPM, open drip-proof type positioned within the unit cabinet for weather protection.
- 15.3.5 The compressors shall be of the hermetic scroll type. The compressor motors shall be lubricated by POE oil and a reversible oil pump. Each compressor shall be equipped with a discharge shut-off valve, a crankcase heater with a safety device which stops the compressor in case of a fault. The compressors shall be mounted on rubber anti-vibration mountings and equipped with discharge mufflers.
- 15.3.6 The evaporator shall be the direct expansion type with carbon steel barrel polypropylene water baffles to resist corrosion and seamless, internally finned high efficiency copper tubes. Tubes shall be internally enhanced, seamless copper type, rolled into tube sheets. Refrigerant heads shall be of carbon steel and removable to permit access to tubes from either end. For easy removal of water, vent and drain plugs shall be provided on the shell. The evaporator shall be equipped with 19mm polyurethane foam and equipped with trace heater. The insulation shall be cemented in place and painted with a resilient vinyl paint to resist cracking. The evaporator shall be designed for refrigerant side working pressure of 2,100 kPa and water side working pressure of 300 kPa. The evaporator shall be designed, constructed, inspected and stamped in accordance with European Directive for Pressurised Equipment 97/23/EC.
- 15.3.7 The condenser coils shall be constructed of 3/8" O.D. internally finned copper tubes and mechanically bonded into plate type aluminium fins. The fins shall have full drawn collars to completely cover the copper tube for protection against atmospheric corrosion. A sub-cooling coil shall be an integral part of the main condense coil. The coils shall be pressure tested to 3,400 kPa.
- 15.3.8 The refrigerant circuit components shall include discharge valves and liquid line shutoff valves, filter driers, moisture indicating sight glasses, electronic expansion devices, high pressure safety switches and a complete operating charge of both refrigerant R32 and compressor oil.



- 15.3.9 Unit controls shall include as a minimum: the microprocessor, the LOCAL/OFF/REMOTE/CCN selector and a 6-digit diagnostic display (scroll-down text) with keypad. The unit shall be capable of performing the following functions:
- Automatic change-over between the main circuit and the non-active circuit(s)
  - Capacity control based on leaving chilled fluid temperature with return fluid temperature sensing
  - Limiting the chilled fluid temperature pull-down rate at start-up to an adjustable range of 0.1°C to 1.1°C per minute to prevent excessive demand spikes at start-up
  - Enable adjustment of leaving chilled water temperature according to the return water temperature or the outdoor temperature or by means of a 0-10 V signal
  - Provide a dual set point for the leaving chilled water temperature activated by a remote contact closure signal
  - Enable a 2-level demand limit control (between 0 and 100%), activated by a remote contact closure or a 0 to 10 V signal
  - Control evaporator water pump operation
  - Enable automatic lead-lag of two chillers in a single system
  - With two time scheduling programs enable unit startup control and set-point change.
- 15.3.10 Unit controls shall be capable of reporting the following diagnostics::
- The display module shall be capable of displaying set points, system status (including temperatures, pressures, run time and percent loading), and any alarm or alert conditions
  - The control shall allow a quick test of all machine elements to verify the correct operation of every switch, circuit breaker, contactor etc. before the chiller is started
  - The control shall be capable of balancing the compressor operating times and the number of compressor startups.
- 15.3.11 Unit controls shall include the following safety features:
- Unit shall be equipped with all necessary components to provide the unit with protection against the following:
- Loss of refrigerant charge
  - Low chilled water temperature
  - Low oil pressure (per compressor)
  - Thermal overload
  - High pressure
  - Electrical overload
  - Circuit pumpdown
  - Low suction temperature
  - Fan motors shall be individually protected by a circuit breaker.

- Control shall provide general alarm remote indication for each refrigeration circuit.
- Control system shall have a RS485 serial output port.
- Unit shall be capable of starting and running at full load at outdoor ambient temperatures from 0°C to 46°C with an evaporator leaving fluid set point from 5°C to 10°C.
- Complete warning and alarm diagnostics to inform operator of warnings and faults in plain English. Warnings and faults are time and date stamped. In addition, the operating conditions that existed just prior to shutdown can be recalled. Specifically, time, date, evaporator and condenser pressures and suction and liquid line temperatures are recorded when alarm occurs.

15.3.12 Each chiller shall be supplied complete with the following additional accessories:

- Soft Starters
- Condenser guard grilles to sides and ends
- Acoustic blanket package to compressors
- Hydronic Module

## 15.4 Construction Products Regulations

- 15.4.1 All products, materials and equipment used on this project shall comply with the Construction Products Regulations. All Construction Products covered by harmonised European Standards must carry a CE mark. The EU Construction Products Regulation (No. 305/2011 - CPR) shall apply in full to all products and materials proposed for use on this project.
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- 15.5.1 In advance of orders being placed for any equipment the contractor shall submit a full technical submittal including specific details of equipment dimensions, operational data, rated power, controls and wiring diagrams, materials specification.
- 15.5.2 The contractor shall include for the provision of 1 No. sample of each item as detailed. Samples to be erected and displayed for design team approval.
- 15.5.3 The contractor shall be responsible for determining quantities from IN2 Engineering Design Partnership drawings and specifications.
- 15.5.4 The contractor shall liaise with the various specialist suppliers to ensure that all necessary fixings kits, supports, connections, etc. are included.
- 15.5.5 The contractor shall refer to IN2 Engineering Mechanical Specification, Section M00 General Specification, part 00.4 "Production of Information - Procurement Details".
- 15.5.6 The contractor shall refer to IN2 Engineering Mechanical Contract Particulars, Section 2.5 Submittal of Alternatives & Section 2.7 Value Engineering.
- 15.5.7 All technical submittals shall be issued in the following format.
- A full index of items, date & revision number of submittal shall be included on the submittal title page.
  - All manufacturers / Suppliers schedules shall refer to IN2 item references.
  - Sections of IN2 specification relevant to the submittal, shall be returned from the manufacturers / Suppliers with each line item labelled by supplier / manufacturer as follows:
    - "Manufacturer / Supplier Initial" & "Compliant" or "Non-Compliant".
    - Should a line item prove non-compliant to spec, the manufacturer / supplier shall include details of proposed alternative.
    - Expected lead-in times shall be included for all items.
    - Where applicable contractor shall propose date for reviewing / approving samples on site.
  - Individual submittals shall be limited to related items of plant/equipment; to prevent re-submission of part-submittals under the same reference, should some items be rejected.

## 15.6 Approved Manufacturers and Vendors

- 15.6.1 The following manufacturers may be considered for the provision of the Chiller plant
- 15.6.2 Chillers
- Daikin or equal and approved.
- 15.6.3 All equipment and ancillary components must be selected from the same manufacturers range.
- 15.6.4 Alternative products / systems will be considered if the contractor can demonstrate that the proposed alternative is equivalent to that specified in all of the following criteria: dimensions, performance, durability, materials, workmanship, quality, service life and aesthetics. Such alternative products / systems will be included in the works only after ER determination and written ER 'approval', which may be refused

## 15.7 Installation

- 15.7.1 All final electrical connections (where applicable) to be made by supplier at expense of mechanical contractor. All connections to be certified as Sub-System using separate Sub-System Completion Certificate. These certificates together with the relevant Test Record Sheets must be submitted to the Project Supervisor for inclusion in Project Safety Manual. Details such as Sub-System Completion Certificate numbers and Sub-System description should be recorded in the comment section of the certificate covering the entire installation.
- 15.7.2 The chillers are to be installed on anti-vibration mountings, on the external roof area, in accordance with the Manufacturer's recommendations.
- 15.7.3 The chillers shall be installed with allowance made for the manufacturer's recommended clearances for air-flow, access and maintenance.
- 15.7.4 The Main Contractor shall include for lifting the chillers into the position as indicated on the drawings.

## 15.8 Testing & Commissioning

- 15.8.1 The chillers shall be tested as erected in their final positions.
- 15.8.2 The Contractor shall provide operator training on machine operation to client personnel.
- 15.8.3 The Contractor shall submit with the tender a recommended list of spare parts to cover the first two years of operation.
- 15.8.4 The mechanical Contractor shall include for full chiller commissioning by the manufacturers' representative

## 15.9 Labelling

- 15.9.1 All pipework shall be identified by means of self-adhesive coloured bands at intervals not greater than 3m, at valve or expansion joint positions, at inlet and exit positions to ducts or buildings and at either side of walls or floors. The identification shall be in accordance with BS 1710: 1984 with colours to BS 4800: 1989.
- 15.9.2 The name of the service should be indicated on an identifying worded band located in a visible position, together with an arrow indicating direction of flow. Flow and return mains should have the letter F or R added to the identifying name.
- 15.9.3 Suppliers shall be requested to label all equipment and packages with identification numbers, to ensure items can be correctly identified.
- 15.9.4 All valves and fittings shall be individually numbered and identified by means of 'traffo labels' securely fixed to the valve or fitting. A valve chart suitably protected with a permanent finish, showing the positions and numbering of the valves should be fixed in an agreed position.

## 15.10 Documentation

- 15.10.1 Upon project completion the contractor shall provide complete Operation and Maintenance instructions with "As installed" drawings.
- 15.10.2 The contractor shall provide the following documentation for all heating plant installations;
- Manufacturer's test conformance sheets.
  - Complete pressure test results indicating:
  - Date of test.
  - Test pressure.
  - Duration of test.
  - Signatures of the contractors witness and engineers' representative witness.
  - Complete commissioning results indicating:
  - Date of commissioning
  - Design flow rates and pressure drops
  - Commissioned flow rates and pressure drops

## 15.11 Extra Materials

- 15.11.1 At practical completion and in addition to handover documentation the following spare parts and items of equipment shall be provided for use by the client;
- As per manufacturer recommendations

## 15.12 Appendix A: Schedule of Chillers

| SCHEDULE OF CHILLERS, BEAUMOUNT AHU AND CHILLER REPLACEMENT<br>B2605 |                          |                              |                          |                        |                                 |                             |                         |                        |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------------------------------------------------|--------------------------|------------------------------|--------------------------|------------------------|---------------------------------|-----------------------------|-------------------------|------------------------|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ref. No.                                                             | Location                 | Type                         | Height (mm)              | Width (mm)             | Length (mm)                     | Nominal Cooling Output (kW) | Fan Air Flow Rate (l/s) | CHW. F&R Conn. (mm)    | SEER kW/kW                 | Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| CH.01                                                                | External Chiller Compund | Air Cooled Outdoor Chiller   | 2,535                    | 2,238                  | 3,694                           | 426.6                       | 38240                   | Ø80                    | 4.93                       | Air cooled outdoor chiller c/w scroll compressor, R32, Duty/Standby VSD pumps, Axial fans, flow swtich, anti-vibration mounts and BCAnet BMS Capability - <b><u>Selection based on - Daikin EWAT-430-SSC2</u></b>                                                                                                                                                                                                                                                                                                                                        |
|                                                                      |                          | Cooling Efficiency EER kW/kW | Inlet/Outlet Water Temps |                        | Water Flow rate system side l/s | Water Pressure drop (kPa)   | Refrigerant             | GWP                    | Compressor Type            | Chiller shall be capable of providing 426.6 kW @ external temperature of 35°C with design flow and return temperatures of 7/12°C.                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                                      |                          | 2.894                        | 7/12°C                   |                        | 20.36                           | 73.3                        | R32                     | 675.0                  | Scroll Step                | Chiller shall be suitable for installation within existing plant constrains and shall incorporate variable capacity control to match system load.                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                                      |                          | Weight (kg)                  | Power Supply             | Max Inrush Current (A) | Running current Nominal (A)     | Running Current Max (A)     | Input Power (kW)        | Sound Power - Lw (dBA) | Sound Pressure (10m) (dBA) | Contractor to decommission, disconnect and remove existing chiller and install new chiller complete with all necessary pipework, electrical and controls modifications. System to be recommissioned with minimal disruption to existing chilled water operation. System to be flushed, refilled and treated following installation in accordance with water treatment requirements. Contractor to ensure existing systems remain protected from contamination during works. All new pipework to be pressure tested and witnessed prior to commissioning. |
|                                                                      |                          | 2951                         | 400V/50 Hz/3~            | 792.0                  | 263.0                           | 344                         | 147                     | 92                     | 60                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |



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## 20.1 Outline Description

- 20.1.1 The Contractor shall be responsible for the supply, installation, commissioning of all Ventilation Plant, Attenuators and ancillary components as detailed on IN2 Engineering Design Partnership drawings:
- Appendix A: Schedule of Air Handling Units.
- 20.1.2 The Mechanical Contractor shall refer to IN2 Engineering Design Partnership Electrical & BMS specifications and drawings, to ensure all equipment is compatible. The Mechanical Contractor shall bring any 'inconsistencies' to the design's attention during the tendering process.
- 20.1.3 The AHU ventilation is based on winter temperatures of -10°C/95% RH and summer temperatures of 30°C/50% RH. Supply air supplied to the spaces shall not drop below 14°C or exceed 32°C. All air systems are full fresh air with heat recovery contained in the central plant. Exhaust and extract air is discharged to atmosphere.
- 20.1.4 It should be noted that the HTMs are to be treated as a minimum requirement throughout this specification, other more onerous requirements are noted where relevant but as an absolute minimum the relevant HTM shall be adhered to. All AHUs should comply fully with the new ErP regulations, contractors are to note that this may require internal adjustments to the AHU components to achieve these requirements. The selected AHUs shall be from a Eurovent certified range.
- 20.1.5 All air handling equipment shall be inspected by the manufacturer and supplier on arrival on site. When they are satisfied each unit shall be presented to the client/design team for inspection. This shall form the arrival inspection and a sign off procedure shall be adopted for these units at this time. The AHUs shall then be inspected by the manufacturer and supplier on construction. When they are satisfied each unit shall be presented to the client/design team for inspection. This shall form the construction inspection and a sign off procedure shall be adopted for these units at this time. It should be noted that no defects shall be accepted in appearance at this time (particular reference to the integrity of the internal finishes). The AHU shall be fully pressure tested to meet the specification pressure test requirements of Class B leakage upon completion of construction. These tests shall be witnessed by the client/design teams and signed off. It is suggested that the manufacturer may want to pressure test the units at factory before delivery.
- 20.1.6 Fresh air and extract shall be from a series of external intakes within the external plant area. All units shall be fully compliant with HTM 03-01 both in terms of layout, construction and quality.
- 20.1.7 All air handlers shall be full fresh air with no risk of mixing return or exhaust air with the intake system.
- 20.1.8 All air handler units shall be capable of delivering air within the temperature range of 14 to 32°C.

- 20.1.9 The fresh air shall be supplied at a temperature that shall depend on the requirements of the space within each department or space served and to minimise the local heating and cooling. As such the control strategy shall be independent for each department and air handling unit. It shall be such that in the first instance the temperature within the department shall be monitored and the air plant shall offset the loads within this space. In general terms the air shall be supplied to satisfy the space with the greatest cooling need, other spaces shall then utilise the VRF system to ensure that the correct supply temperature is provided to meet the space requirements and maintain acceptable space conditions. Temperature differentials shall at all times meet the requirements of HTM 03-01. Some small spaces such as stores will have air supplied at a temperature and condition the same as that of the surrounding spaces.
- 20.1.10 All ductwork shall be insulated in accordance with the specification and HTM 03-01. There should be no uninsulated ducting on the project. All ducting insulation shall be mineral fibre with a minimum thermal conductivity performance 0.035 W/m·K at 10°C mean temperature. Density to be 28-45kg/m<sup>3</sup> with a reinforced aluminium foil finish excepting plant areas and risers where a metal clad finish shall be provided. External ducting shall be metal clad with a Black PIB waterproof layer between the insulation and its finish. All insulation shall be A+ rating in the Green Guide. All insulation shall prevent the spread of flame. Flexible ducts used for connections to terminal units shall be insulated and shall be no more than 300mm in length, these shall not be used to correct offsets or alignment issues.
- 20.1.11 All intake and exhaust louvres shall be complete with removable insect mesh. This shall be removable from within the building to allow future cleaning and this removal shall be demonstrated to the client prior to handover. All louver areas are to be calculated on a maximum intake jet velocity of 2.0m/s and maximum exhaust jet velocity of 2.5m/s.
- 20.1.12 In general, all ventilation ductworks shall be galvanised sheet metal to DW144 Class B with all necessary volume control dampers, access doors, fire or smoke dampers, supply air diffusers and return air/ exhaust air grilles, reheat coils and any necessary transfer grilles. All air ductwork, (that is supply, return, exhaust and transfer ducting) shall be insulated in accordance with HTM 03-01, IN2 specification. All ducting shall be insulated with mineral with foil backing finish. All ductworks shall be examined by the engineer prior to the installation of insulation to ensure there is no physical damage covered; we would suggest that the pressure testing of the ductwork be carried out prior to the insulation being applied as should an issue arise during this test full rectification will be required including all making good.
- 20.1.13 Duct cleanliness shall be in line with the requirements of HVCA TR19 (including pre-commissioning specialist clean). It should also be noted that there is a requirement to ensure all ducting on site is kept capped at all times during construction, where a duct is opened for working it should be wiped down internally and resealed upon completion of the section as for PDI level 2. Duct cleanliness is to be tested to High Standard as laid out in BS EN 15780 prior to handover and a specialist cleaning company employed to sign off this requirement. It is imperative that the contractors take the advice of the specialist cleaning company in respect of the cleaning methodology as it is likely to impact on access requirements as noted above. In all cases the HTM shall apply.

- 20.1.14 Attenuators shall be constructed in accordance with DW144 specification for medium class ducting and shall be included in the pressure test of their locations. Cases are to be stiffened with welded on proprietary 30mm profile flanges. For rectangular units sound absorbent splitters are to be arranged in vertically within the casing to form a series of central elements and side linings. For circular units a single sound absorbent splitter shall be mounted mid airstream in a pod arrangement with side linings around the perimeter. All splitters are to have aerodynamic fairings at each end and mounted using a double row of steel rivets. Attenuators may be modular depending on size, but the pressure test will be on the sully constructed and installed unit. The units shall be constructed from 1.2mm thick (minimum) pre-galvanised steel with a double skin casing, melinex encapsulated infills to allow cleaning. Construction tolerances shall be no more than +/-3mm.
- 20.1.15 The Mechanical Contractor shall be responsible for the Design, Selection and installation of the complete support & Bracketry systems (inc Anit-Vib mounts, plinths & proprietary support systems) including anchor systems and metal framing supports etc. The Contractor shall be responsible for determining the appropriate components, materials and methods of installation based on the fully loaded capacities +50% of proposed systems / equipment and the structure from which the systems / equipment is to be mounted. All support system hangers shall be spaced at intervals of not greater than those laid out in the services specific section of the specification and when fully loaded shall not deflect between supports. The Contractor shall consider all requirements when making selections and shall reduce spacing of supports as required but shall not increase spacings. Additional supports are to be provided at intersections and any changes in direction.
- 20.1.16 The Contractor shall provide details of all anchors and fixings for review by the Structural Engineers and shall allow for "pull-out" testing to verify selections based on site conditions.
- 20.1.17 The Mechanical Contractor shall carefully read the notes on the drawings and include for all associated costs in his tender.

## 20.2 Standards

20.2.1 The ventilation plant shall comply with the requirements of the following standards:

- BS 5720:1979 Mechanical ventilation and air conditioning in buildings
- BS ISO 10302-1:2011 Acoustics. Measurement of airborne noise emitted, and structure-borne vibration induced by small air-moving devices. Airborne noise measurement.
- BS ISO 14694:2003 Fans for general purposes. Specifications for balancing and vibration (+A1:2011)
- BS EN IEC 60879:2019 Comfort fans and regulators for household and similar purposes. Methods for measuring performance
- BS EN ISO 5801:2017 Fans. Performance testing using standardized airways
- (EU) No 1253/2014 Implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for ventilation units

20.2.2 All ventilation plant shall comply with the following Specific Fan Power requirements (unless otherwise stated):

| <b>Table 4 Maximum specific fan power in air distribution systems</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>System type</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>SFP<br/>(W/(l/s))</b> |
| Central balanced mechanical ventilation system with heating and cooling                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1.6                      |
| Central balanced mechanical ventilation system with heating only                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1.5                      |
| All other central balanced mechanical ventilation systems                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1.1                      |
| Zonal supply system where fan is remote from zone, such as ceiling void or roof-mounted units                                                                                                                                                                                                                                                                                                                                                                                                                          | 1.1                      |
| Zonal extract system where fan is remote from zone                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.5                      |
| Zonal supply and extract ventilation units, such as ceiling void or roof units serving single area with heat recovery                                                                                                                                                                                                                                                                                                                                                                                                  | 1.9                      |
| Local balanced supply and extract ventilation system such as wall/roof units serving single area with heat recovery                                                                                                                                                                                                                                                                                                                                                                                                    | 1.6                      |
| Local supply or extract ventilation units such as window/wall/roof units serving single area (e.g. toilet extract)                                                                                                                                                                                                                                                                                                                                                                                                     | 0.3                      |
| Other local ventilation supply or extract units                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.5                      |
| Fan assisted terminal VAV unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.1                      |
| Fan coil unit (rating weighted average <sup>1,2</sup> )                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.5                      |
| Kitchen extract, fan remote from zone with grease filter                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1.0                      |
| <p>The rating weighted average is calculated by the following formula:</p> $\frac{P_{\text{mains}1} \times \text{SFP1} + P_{\text{mains}2} \times \text{SFP2} + P_{\text{mains}3} \times \text{SFP3}}{P_{\text{mains}1} + P_{\text{mains}2} + P_{\text{mains}3}}$ <p>Where <math>P_{\text{mains}}</math> is useful power supplied from the mains.</p> <p>NEAP assumes a value of SFP for the fancoil system, so this figure should not be added to the SFP for the fan coil units when entering the data into SBEM</p> |                          |
| <b>Table 5 Extending specific fan power for additional components</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                          |

| Component                                                                                                                                              | SFP<br>(W/(l/s)) |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Additional return filter for heat recovery                                                                                                             | +0.1             |
| HEPA Filter1                                                                                                                                           | +1.0             |
| Heat Recovery -Thermal Wheel system                                                                                                                    | +0.3             |
| Heat Recovery-other systems                                                                                                                            | +0.3             |
| Humidifier / Dehumidifier (air conditioning systems)                                                                                                   | +0.1             |
| HEPA Filtration is recognized as an option in NEAP. The pressure drop can be specified or NEAP will assume a default value from the activity database. |                  |

- 20.2.3 The temperature efficiency at equal airflows of all Run-Around-Coil systems shall be no less than 68% and for other energy recovery systems 73%.
- 20.2.4 All Rotary heat exchangers shall have a variable speed drive which is controlled to provide the set temperature.
- 20.2.5 All Plate heat exchangers (both cross flow and counter flow) shall have a bypass damper.
- 20.2.6 The mechanical contractor shall ensure that all relevant standards are adhered in specification and installation of all extract fans.

## 20.3 Equipment

### 20.3.1.1 Extract Fans

- 20.3.2 All extract fan units shall include a double-skinned housing and be suitable for in-line, internal installation. All internal surfaces of fan casings to be treated with fire-retardant acoustic material. High density internal acoustic treatment shall be included to ensure the following noise criteria are met:
- 20.3.3 Maximum break out sound power level of 35dB(A).
- 20.3.4 Maximum inlet sound power level of 40dB(A).
- 20.3.5 Maximum outlet sound power level of 40dB(A).
- 20.3.6 Fans shall be selected to allow an increase in duty to **120%** of design air volume at **120%** of design external static pressure.
- 20.3.7 Twin Fans shall be of high efficiency backward-curved centrifugal type, manufactured in galvanised steel, **unless otherwise stated**. Fans shall be direct drive with high efficiency motors.
- 20.3.8 Single Fans shall be of high efficiency backward-curved centrifugal type, manufactured in galvanised steel, **unless otherwise stated**. Fans shall be direct drive with high efficiency motors.
- 20.3.9 All fans (inc those contained within packaged plant items i.e. AHU's, FCU's, HRU's & Fume Cupboards etc<sup>1</sup>) shall be fitted with an integral controller complete with an inverter variable speed controller. Fans shall feature 'soft-starting' and 'step-less' variable speed control. All fans shall be capable of control & monitoring by BMS.
- 20.3.10 All fans & AHU's shall have a specific fan power of **less than 1.2W/Ltr.s<sup>-1</sup>**, at rated duty.
- 20.3.11 All Air Handling Units shall have a (Total) specific fan power of **less than 1.8W/Ltr.s<sup>-1</sup>**, at rated duty.
- 20.3.12 All Heat Recovery Units & Fan Coil Units shall have a specific fan power of **less than 0.3W/Ltr.s<sup>-1</sup>**, at rated duty.
- 20.3.13 All extract fan assemblies shall incorporate airflow fail monitors.
- 20.3.14 All extract fans shall come complete with a minimum 5 years warranty.
- 20.3.15 All extract fans shall come complete with flexible connectors. The flexible connectors shall be flangeless. The flexible duct material shall be flameproof and resistance to heat up to 132°C, chemicals, ozone, oil and grease. The material shall be airtight, waterproof and tested to BS476 Part 7. The flexible connectors shall be supplied complete with fixing straps.
- 20.3.16 All extract fans shall come complete with attenuators, constructed from 'Solissime' coated galvanised steel designed for fixing directly to fan outlet. Fans shall be internally lined with mineral wool packed to a density greater than 45kg/m<sup>3</sup>. The attenuator 'sound absorbing material' shall be chemically inert, non-combustible, non-hygroscopic and vermin resistant. The attenuator shall be tested in accordance with BS718:1971 ASTM E 477. The attenuator shall be suitable for internal and external use at any installed angle.
- 20.3.17 All extract fans shall come complete with appropriate anti-vibration mounts.







20.3.18

20.3.19 Each fan unit shall incorporate full control package enclosed within the unit. Integrated unit controls shall include automatic fan speed control. Please see IN2 Engineering BMS Specification M71 BMS General Descriptions of Operation, for description of required controls system operation.

### 20.3.19.1 Air Handling Unit

20.3.20 The Air Handling Units shall comply with the requirements of the following classifications:

- Mechanical strength classification: Class D1(M) maximum deflection 1.2mm/m at  $\pm 1000\text{Pa}$
- Casing air leakage class: Class D1(M) maximum deflection 1.2mm/m at  $\pm 1000\text{Pa}$
- Filter section bypass leakage:  $\pm 400\text{Pa}$  Percentage leakage 0.2% with filter class G1-F9
- Casing thermal transmittance: Class T1 maximum thermal transmittance : $0.5\text{W.m}^2/\text{k}$
- Casing thermal break: Class TB1  $0.75 \leq \text{thermal bridging factor} < 1.00$
- Minimum Acoustic Insulation of casing (additional treatment may be required to achieve the noise levels stated in the data sheets):
  - 125Hz - 10.3dB
  - 250Hz - 11.6dB
  - 500Hz - 11.2dB
  - 1000Hz - 12.4dB
  - 2000Hz - 18.1dB
  - 4000Hz - 32.6dB
  - 8000Hz - 39.3dB

20.3.21 20.3.2.1 As part of the approval process to ensure compliance with the above standards the engineer will require copies of the relevant:

- Eurovent certificate.
- Laboratory test results to EN1886:2008
- The unit manufacturer shall be listed on the Eurovent website.

### 20.3.21.1 Casing

- 20.3.22 Composite panels shall have a total thickness of 60 mm, inner 1.2mm thick (corrosion resistance shall be no less than 10x that of galvanised steel.) corrosion resistant sheet metal and outer 1.2mm thick plastic-coated sheet metal with hot injected 90kg/m<sup>3</sup> polyurethane (flame resistance class 2B thermal conductivity 0.026W/m.k. The unit floor shall be made of 1.0mm thick stainless steel AISI 304 perfectly sealed (using silicone) to allow cleaning by steam or water, each floor panel shall be sloped to a drainage channel and drain for water drainage to be connected to unit side the unit. All external panels shall be secured to the modular frames with stainless steel noncorrosive fixings (not pop-rivets or self-drilling screws).
- 20.3.23 To ensure the required thermal transmittance and thermal break conditions are achieved, the unit construction shall incorporate polyamide strip thermal break.
- 20.3.24 Internal profile corners shall have filleted radii (rounded) to avoid 90° corners.
- 20.3.25 Bearing framework constructed of 250 mm extruded aluminium section, including mitred aluminium corner elements. The base frame shall be complete with lifting eyes to accommodate spreader bars to avoid damage during craning operations.
- 20.3.26 Access doors shall be provided for maintenance purposes to the filter sections, fan sections, before and after each coil section. Doors shall be provided with a minimum of 3 No. hinges. Each door shall have closed cell perimeter door and panel seals and close tightly against a polyurethane gasket. All doors to be key lockable. Access doors on sections under positive pressure shall open inwards, access doors on sections under negative pressure shall open outward to ensure a correct seal during operation. All door hinges shall incorporate stainless steel fixings.
- 20.3.27 Frame corners shall be corrosion resistant and suitable for use in aggressive salty coastal conditions.
- 20.3.28 Mono pitched plastic-coated sheet metal insulated roof, sloped away from access sections.
- 20.3.29 Minimum 500mm Access Sections with integrated LED lighting, factory wired to IP67 switch on outside of the unit and access section door shall include a double-glazed inspection window.
- 20.3.30 The air handling unit shall be delivered in sections and shall be factory wrapped in strong plastic and suitable for transportation and storage outdoors until the building is weathered.

### 20.3.30.1 Damper Sections

- 20.3.31 Intake and Discharge sections. The intake and discharge sections shall be complete with motorised Shut-off Dampers and louvres. The dampers shall be constructed from peraluman which is marine grade aluminium complete with 150mm high double skin blades. The blades shall be rotated by solid steel bar linkage mechanism attached to the blade shaft. Plastic or polymer-based linkages or gears shall not be permitted. The dampers shall comply with the requirements of EN1751 Class 4. Dampers must be suitable for mounting an actuator (actuator by others)
- 20.3.32 The intake and exhaust dampers may be mounted external to the AHU casing. All dampers shall be suitable for a maximum face velocity of 3.0 m/s.
- 20.3.33 All dampers shall be independently modulating and shall be suitable for motorised operation. On large dampers, multiple actuators shall be used to ensure that the maximum capacity of the actuator is not exceeded.

- 20.3.34 All Plate heat exchangers shall come complete with a modulating, motorised, by-pass damper as standard.
- 20.3.35 Shut-off Dampers. The dampers shall be constructed from peraluman which is marine grade aluminium complete with 150mm high double skin blades. The blades shall be rotated by solid steel bar linkage mechanism attached to the blade shaft. Plastic or polymer-based linkages or gears shall not be permitted. The dampers shall comply with the requirements of EN1751 Class 4.

### 20.3.35.1 Filters

- 20.3.36 Filters shall comply with the following standards:

- Filter efficiency groups G and F: EN 779/2002

| Group  | Filter Class | Average Arrestance (%) | Average Efficiency @ 0.4 µm (%) | Minimum Efficiency @ 0.4 µm (%) |
|--------|--------------|------------------------|---------------------------------|---------------------------------|
| Coarse | G1           | 50 - 65                | -                               | -                               |
|        | G2           | 65 - 80                | -                               | -                               |
|        | G3           | 80 - 90                | -                               | -                               |
|        | G4           | 90≤                    | -                               | -                               |
| Medium | M5           | -                      | 40 - 60                         | -                               |
|        | M6           | -                      | 60 - 80                         | -                               |
| Fine   | F7           | -                      | 80 - 90                         | 35                              |
|        | F8           | -                      | 90 - 95                         | 55                              |
|        | F9           | -                      | > 95                            | 70                              |

- Filter Efficiency groups H: EN 1822

| Group | Filter class | Integral value        |             | Local value           |             |
|-------|--------------|-----------------------|-------------|-----------------------|-------------|
|       |              | Filtration efficiency | Penetration | Filtration efficiency | Penetration |
| EPA   | E 10         | 85 %                  | 15 %        | -                     | -           |
|       | E 11         | 95 %                  | 5 %         | -                     | -           |
|       | E 12         | 99.5 %                | 0.5 %       | -                     | -           |
| HEPA  | H 13         | 99.95 %               | 0.05 %      | 99.75 %               | 0.25 %      |
|       | H 14         | 99.995 %              | 0.005 %     | 99.975 %              | 0.025 %     |
| ULPA  | U 15         | 99.9995 %             | 0.0005 %    | 99.9975 %             | 0.0025 %    |
|       | U 16         | 99.99995 %            | 0.00005 %   | 99.99975 %            | 0.00025 %   |
|       | U 17         | 99.999995 %           | 0.000005 %  | 99.9999 %             | 0.0001 %    |

- All Filter media shall fully compliant with HTM guidance.
- Each filter shall have diagonal support members bonded to the air entry and exit side of each pleat to give the pleat stability.
- All panel filters shall be suitable for a maximum face velocity of 2.5 m/s at 125% design flow rate.

### 20.3.36.1 Coil section

- LTHW & CHW coils will be selected for a maximum face velocity of 2.5 m/s.
- LTHW & CHW coils shall be suitable for the flow rates and outputs as detailed in the schedules.
- Specified air handling units shall come complete with integral frost, heating and cooling coils, suitable for a minimum to maximum operating temperatures as dictated by LTHW and CHW circuits.
- All coils shall be complete with BMS interface for monitoring and control.

### 20.3.36.2 Louvres

20.3.37 Louvers shall be provided by manufacturer where AHU fresh air supply and/or exhaust air connections are open to atmosphere. All louvers shall be externally rated weathered louvers with a minimum free area of 50%

### 20.3.37.1 Motors

20.3.38 Motors shall be:

- IP55 protection standard
- Class F
- Efficiency minimum IE3 class 1
- Balancing level R
- Aluminium and die-cast iron casing, depending on size
- Adjustable terminal board positioned on top
- Voltage 400-660/3Ph/50-60Hz
- Factory pre-wired to IP67 4-pole isolator with auxiliary contacts
- Fan motor unit shall also include:
  - Motor slide
  - Flanged vibration-dampening collar
  - Spring vibration-damping supports
- Tool free slide-out arrangement for quick fan change and inspection, including quick disconnects to fan power supply
- Security/protection grid to the plug fan impeller
- Fans shall be standard cycle c epoxy coated to RAL5015 for improved corrosion resistance.
- Supply and Extract Motors. The motors shall be high efficiency IE3. Motors shall be complete with lifting eyes for safe removal of the motors. The motor shall be

sized in order to provide 60% extra spare capacity on the design pressure and airflow.

- The motors in all fans are fitted with high temperature automatic cut-out protection.
- All fans motors shall come complete with variable speed drives. All fans shall be capable of operating 'constant pressure'.
- All motors shall be provided with mains control and isolation, with auxiliary contacts to be wired back to the control panel by the site electrical contractor for interlocking with the fan starter.

### 20.3.38.1 Fans

20.3.39 Fan impellers shall be aerofoil profile backward inclined and comply with the following standards:

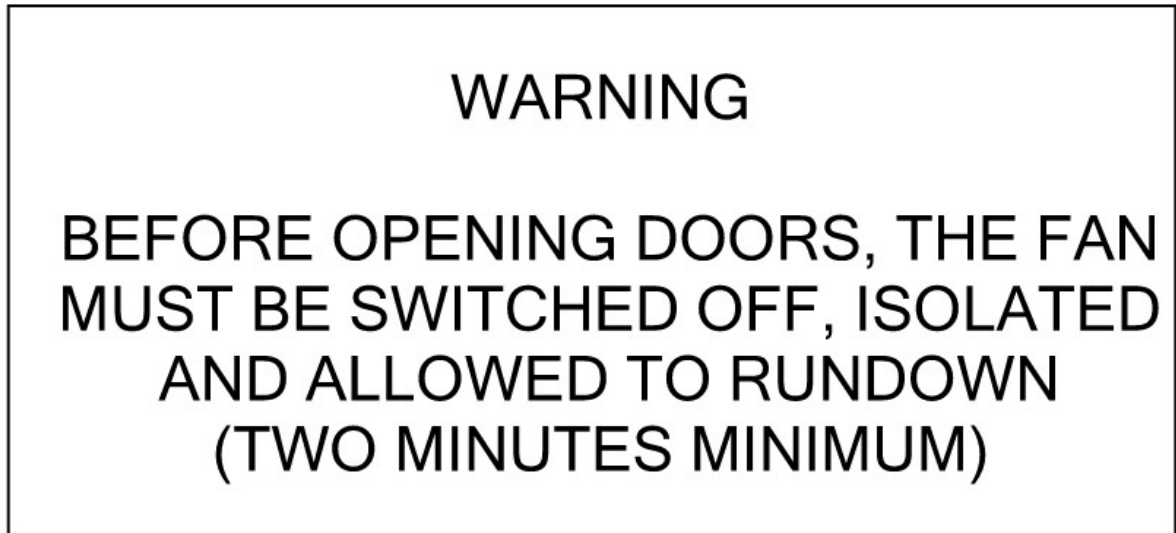
- Operating Features: DIN 24163 or BS 848 Part 1
- Sound Power Level: DIN 45635 or BS 848 Part 2
- Balancing: DIN ISO 1940-1 or ANSI S2-19
- Vibration: ISO 2372 or VDI 2056

20.3.40 Structurally fans shall possess

- Statically and dynamically balanced wheels in accordance with DIN ISO 1940-1, minimum quality standard of G 6,3 and performance in accordance with DIN 24163
- All fans assembled with their own motor shall be individually tested in the factory and an appropriate certificate issued for each fan
- All AHU fans shall have a specific fan power of less than 2 W / Ltr.s-1.
- Fan performance shall be tested in accordance with BS848.
- Fans shall be selected to allow an increase in duty to 110% of design air volume at 120% of design external static pressure.
- Guards shall be provided for all fan drives and shall be securely fastened in accordance with IS EN 292-2.
- The entire side-wall of the fan chambers shall be easily removable for removal of the fan and motor on its fan motor frame as single assembly should this be necessary.
- Access doors shall be provided with a double-glazed shatter resistant inspection window, 210mm in diameter.
- The fan sections shall be fitted with an IP67 LED light fitting to give a minimum of 210 lux within the fan chamber. The light will be pre-wired to an external IP

67 switch mounted on the AHU casing beside the access door. Lamps shall be of high efficiency compact fluorescent type.

- The access door shall be provided with a warning label to read:



- All AHU's shall come complete with a fan over-run timer

#### 20.3.40.1 Attenuators

- Attenuation media shall be suitable for use in hospital environments and fire resistant (in compliance with HTM 05-02). The media shall include an outer lining material to prevent fibre migration and contamination of the media, shall be wet cleanable with a declared service life in excess of 25 years. The sheet

metal splitter shall be constructed of grade 304 stainless steel and be aerodynamically shaped to minimise pressure drop and turbulence.

## 20.4 Construction Products Regulations

- 20.4.1 All products, materials and equipment used on this project shall comply with the Construction Products Regulations. All Construction Products covered by harmonised European Standards must carry a CE mark. The EU Construction Products Regulation (No. 305/2011 - CPR) shall apply in full to all products and materials proposed for use on this project.
- All products where applicable must comply with relevant Harmonised European Standards (hENs)
- 20.4.2 All products must be provided with a Declaration of Performance (DoP). The DoP must be provided by the manufacturers and must provide information relating to the characteristics of the product and confirm the conformity of the construction product with the declared performance. The CE mark attributed to the product must follow the DoP.
- 20.4.3 All technical submittals for products and equipment proposed by the Contractor must include all relevant DoP's, and must in the first instance be verified by the Contractor before submitting to the Employers Representative or Engineer. The Contractor must verify that the products being proposed do comply with the DoP and are suitable for their intended use in construction works and suitable for the application intended. The Contractor must also refer to National Standards to ensure that any National minimum standards for specific intended uses of the product in Ireland are complied with. Where such verifications and a DoP has not been provided as part of the technical submittal, the submittal will be deemed invalid and will not be considered. No claims for time lost, or cost increases owing to a potential change in the products or materials shall be considered by the Engineer or Employers Representative as a result.
- 20.4.4 The Contractor as part of his "Ancillary Certifiers" role under Building Control Amendment Regulations (BCAR), shall maintain a record of all DoP's and shall include same as part of his Inspection Plan records and reports.
- 20.4.5 The manufacturer's must fully comply with their obligations under the Construction Product Regulations, and shall if requested provide any additional, or supplementary information as may be requested by the Engineer or Employers Representative as may be considered necessary. In the event of such information not being forthcoming within a timely manner the Contractors proposal shall be rejected. No claims for time lost, or cost increases owing to a potential change in the products or materials shall be considered by the Engineer or Employers Representative as a result.
- 20.4.6 The Contractor must ensure compliance with Building Regulations and as such, all works must be carried out using proper materials that are fit for the use for which they are intended and for the conditions in which they are to be used.
- 20.4.7 The Contractor shall refer to the details within the Construction Products Regulation (CPR), and all annex's therein and shall ensure that all related elements are fully satisfied.



## 20.5 Samples & Technical Submittals

- 20.5.1 In advance of orders being placed for any equipment the contractor shall submit a full technical submittal including specific details of equipment dimensions, operational data, rated power, controls and wiring diagrams, materials specification.
- 20.5.2 The contractor shall include for the provision of 1 No. sample of each item as detailed. Samples to be erected and displayed for design team approval.
- 20.5.3 The contractor shall be responsible for determining quantities from IN2 Engineering Design Partnership drawings and specifications.
- 20.5.4 The contractor shall liaise with the various specialist suppliers to ensure that all necessary fixings kits, supports, connections, etc. are included.
- 20.5.5 The contractor shall refer to IN2 Engineering Mechanical Specification, Section M00 General Specification, part 00.4 "Production of Information - Procurement Details".
- 20.5.6 The contractor shall refer to IN2 Engineering Mechanical Contract Particulars, Section 2.5 Submittal of Alternatives & Section 2.7 Value Engineering.
- 20.5.7 All technical submittals shall be issued in the following format.
- A full index of items, date & revision number of submittal shall be included on the submittal title page.
  - All manufacturers / Suppliers schedules shall refer to IN2 item references.
  - Sections of IN2 specification relevant to the submittal, shall be returned from the manufacturers / Suppliers with each line item labelled by supplier / manufacturer as follows:
  - "Manufacturer / Supplier Initial" & "Compliant" or "Non-Compliant".
  - Should a line item prove non-compliant to spec, the manufacturer / supplier shall include details of proposed alternative.
  - Expected lead-in times shall be included for all items.
  - Where applicable contractor shall propose date for reviewing / approving samples on site.
  - Individual submittals shall be limited to related items of plant/equipment; to prevent re-submission of part-submittals under the same reference, should some items be rejected.

## 20.6 Approved Manufacturers and Vendors

- 20.6.1 The following manufacturers may be considered for the provision of the extract fans.
- Wolf, as supplied by Exi-tite or equal and approved.
- 20.6.2 All equipment and ancillary components must be selected from the same manufacturers range.
- 20.6.3 Alternative products / systems will be considered if the contractor can demonstrate that the proposed alternative is equivalent to that specified in all of the following criteria: dimensions, performance, durability, materials, workmanship, quality, service life and aesthetics. Such alternative products / systems will be included in the works only after Employer Representative determination and written Employer Representative 'approval', which may be refused

## 20.7 Installation

- 20.7.1 All final electrical connections (where applicable) to be made by supplier at expense of mechanical contractor. All connections to be certified as Sub-System using separate Sub-System Completion Certificate. These certificates together with the relevant Test Record Sheets must be submitted to the Project Supervisor for inclusion in Project Safety Manual. Details such as Sub-System Completion Certificate numbers and Sub-System description should be recorded in the comment section of the certificate covering the entire installation.

### 20.7.1.1 Extract Fans

- 20.7.2 All extract fans are to be installed as indicated on IN2 Engineering Design Partnership drawings.
- 20.7.3 All extract fans shall be installed so as to be readily accessible for future maintenance.
- 20.7.4 Mechanical contractor shall liaise with Electrical contractor to coordinate wiring of fans.
- 20.7.5 Mechanical contractor shall liaise with Electrical contractor for installation of PIR's, required for operation of extract fans.
- 20.7.6 The Mechanical Contractor shall allow for all necessary ductwork transformation and flexible connections for the complete installation of the extract fans.

### 20.7.6.1 Attenuators

- 20.7.7 All Attenuators are to be installed as indicated on IN2 Engineering Design Partnership drawings.
- 20.7.8 The Mechanical Contractor shall allow for all necessary ductwork transformation and flexible connections for the complete installation of the In-Line Attenuators.
- 20.7.9 All attenuators must be selected from the same manufacturers range as the associated extract fan.

### 20.7.9.1 Air Handling Units

- 20.7.10 All AHU's shall be installed in accordance with HTM guidelines.
- 20.7.11 All AHU's are to be installed as indicated on IN2 Engineering Design Partnership drawings.
- 20.7.12 All AHU's shall be installed so as to be readily accessible for future maintenance.
- 20.7.13 Mechanical contractor shall liaise with Electrical contractor to coordinate wiring of AHU's.
- 20.7.14 The Mechanical Contractor shall allow for all necessary ductwork transformation and flexible connections for the complete installation of the AHU's.

## 20.8 Testing & Commissioning

- 20.8.1 The Mechanical Contractor shall include for ventilation system to be installed, balanced and commissioned by competent installers e.g. QQI or ETB or equivalent. Commissioning data shall include airflow rates, pressure drops for all ventilation items.

- 20.8.2 The Mechanical Contractor shall include validation of the ventilation commissioning data to ensure that they achieve the design flow rates by an independent third party competent person i.e. NSAI certified or equivalent.

## 20.9 Labelling

- 20.9.1 All ductwork shall be identified by means of self-adhesive coloured bands at intervals not greater than 3m, at valve or expansion joint positions, at inlet and exit positions to ducts or buildings and at either side of walls or floors. The identification shall be in accordance with BS 1710: 1984 with colours to BS 4800: 1989.
- 20.9.2 The name of the service should be indicated on an identifying worded band located in a visible position, together with an arrow indicating direction of flow.
- 20.9.3 Suppliers shall be requested to label all equipment and packages with identification numbers, to ensure items can be correctly identified.
- 20.9.4 All dampers and fittings shall be individually numbered and identified by means of 'traffo labels' securely fixed to the valve or fitting. A damper chart suitably protected with a permanent finish, showing the positions and numbering of the dampers & VCD's should be fixed in an agreed position.

## 20.10 Documentation

- 20.10.1 Upon completion of the project the contractor shall provide the following documentation;
- Operation & Maintenance manual documentation.
  - Test results indicating:
    - Date of test
    - Duration of test
  - Signatures of the contractors witness and engineers representative witness.
  - Commissioning results indicating:
    - Date of commissioning
    - Design flowrates and pressure drops
    - Commissioned flowrates and pressure drops

## 20.11 Extra Materials

- 20.11.1 At practical completion the contractor shall undertake to replace all panel and bag filters to Air Handling Units at the end of the construction phase immediately prior to handover.
- 20.11.2 At practical completion and in addition to handover documentation the following spare parts and items of equipment shall be provided for use by the client;
- A complete set of replacement filters for the Client's future use.

## 20.12 Appendix A: Schedule of Air Handling Units.

**SCHEDULE OF AIR HANDLING UNITS, B2405**

|                              |                       |                         |           |                                       |                       |                                    |      |  |  |  |  |
|------------------------------|-----------------------|-------------------------|-----------|---------------------------------------|-----------------------|------------------------------------|------|--|--|--|--|
| System Served / Make / Model |                       |                         |           | AHU.01 - Supply & Extract             |                       |                                    |      |  |  |  |  |
| Area Served                  |                       |                         |           | Radiology & X-Ray Rooms               |                       |                                    |      |  |  |  |  |
| Dimensions                   |                       |                         |           | Supply Unit                           |                       |                                    |      |  |  |  |  |
|                              |                       |                         |           | Length                                | 6890                  | Height                             | 1430 |  |  |  |  |
|                              |                       |                         |           | Width                                 | 2100                  | Total AHU Weight                   | 4308 |  |  |  |  |
|                              |                       |                         |           | Extract Unit                          |                       |                                    |      |  |  |  |  |
|                              |                       |                         |           | Length                                | 3790                  | Height                             | 1510 |  |  |  |  |
| Supply Fan                   |                       |                         |           | Extract Fan                           |                       |                                    |      |  |  |  |  |
| Duty                         | 3.60m <sup>3</sup> /s |                         |           | Duty                                  | 3.60m <sup>3</sup> /s | Supply Air Attenuator (NR 30 max)  |      |  |  |  |  |
| Fan ESP                      | 350Pa                 |                         |           | Fan ESP                               | 350Pa                 | Length                             |      |  |  |  |  |
| Motor Power                  | 400W/3Ph/50Hz XXXAmps |                         |           | Motor Power                           | 230W/1Ph/50Hz XXXAmps | Extract Air Attenuator (NR 30 max) |      |  |  |  |  |
| Unit Access                  | HTM Compliant         |                         |           | Unit Access                           | HTM Compliant         | Length                             |      |  |  |  |  |
| Front Coil                   | Re-heat Coil          |                         |           | Run Around Coil                       |                       | Intake Air Attenuator (NR 40 max)  |      |  |  |  |  |
| Air on                       | -5°C                  | Air on                  | 14°C      | Air on                                | 7                     | Length                             |      |  |  |  |  |
| Air off                      | 7°C                   | Air off                 | 30°C      | Air off                               | 22                    | Exhaust Air Attenuator (NR 40 max) |      |  |  |  |  |
| Water flow                   | 80°C                  | Water flow              | 80°C      |                                       |                       |                                    |      |  |  |  |  |
| Water return                 | 60°C                  | Water return            | 60°C      |                                       |                       |                                    |      |  |  |  |  |
| Coil Rating                  | 52.9kW                | Coil Rating             | 70.6kW    |                                       |                       |                                    |      |  |  |  |  |
| Water ΔP                     | 20kPa MAX             | Water ΔP                | 20kPa MAX |                                       |                       |                                    |      |  |  |  |  |
| Cooling Coil                 |                       |                         |           | Energy Class (EN308)                  |                       |                                    |      |  |  |  |  |
| Air on                       | 30°C                  | All coils to be CU/CU   |           | H3                                    |                       |                                    |      |  |  |  |  |
| Air off                      | 18°C                  | Sound Power Level (LWA) |           |                                       |                       |                                    |      |  |  |  |  |
| Coil Rating                  | 52.9kW                | 50                      |           |                                       |                       |                                    |      |  |  |  |  |
|                              |                       |                         |           | Spare M5 & E9 filters to be provided  |                       |                                    |      |  |  |  |  |
|                              |                       |                         |           |                                       |                       |                                    |      |  |  |  |  |
|                              |                       |                         |           | AHU Specific col. power demand (SFPv) |                       |                                    |      |  |  |  |  |
|                              |                       |                         |           | Max. SFPv                             |                       |                                    |      |  |  |  |  |
|                              |                       |                         |           | 2.2kW/(m <sup>3</sup> /s)             |                       |                                    |      |  |  |  |  |

**Notes:**

All coils to operate across entire control valve range open to closed with no water stratification in the coil.

All fans to be complete with dampers on intakes. Unit shall comply with the Ecodesign Directive 2009/125/EC (ErP Directive). Units are constructed to our standard construction specification, with our standard materials, door furniture and finish unless quoted otherwise.

D/W144 Class 'C' Air Leakage rate (L1/L2) achieved for standard construction. Fully enclosed Aluminium Extrusion framework, with Corrosion Free anodised and Cold Bridge free construction.

All units complete with integral formed base frame, 300mm painted to the same colour/finish as the outer panels Mineral wool insulation 45 mm double skinned step panel system.

Both Inner & Outer panel skins for the external units pre-coated sheet steel. Unit to be Eurovent certified and to EN1886 Standard, based on the Air Handling Units offered.

Mechanical Casing Strength 1 Casing Air Leakage (-400Pa) L 1/L2 Casing Air Leakage (+700Pa) L 1/L2 Thermal Transmittance 2. Thermal Bridging Factor B2.



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## 22.1 Outline Description

- 22.1.1 The Ventilation Installations shall comprise the following ventilation systems:
- 22.1.2 Ventilation Systems;
- Vent System Type 1 - Existing Supply ventilation systems serving radiology department
  - Vent System Type 2 - Existing Extract ventilation systems serving radiology department
  - Vent System Type 3 - Any necessary changes to existing ductwork within the V6B plantroom, for coordination purposes, as indicated on IN2 Engineering Design Partnership drawings, and any other necessary changes found on site - (to be agreed with TSD prior to installation, including any necessary shutdowns and phasing)
- 22.1.3 The Mechanical Contractor shall be responsible for the supply and installation, of all ventilation systems as detailed as indicated on IN2 Engineering Design Partnership drawings.
- 22.1.4 The Mechanical Contractor shall be responsible for the Design, Selection and installation of the complete support & Bracketry systems (inc Anit-Vib mounts, plinths & proprietary support systems) including anchor systems and metal framing supports etc. The Contractor shall be responsible for determining the appropriate components, materials and methods of installation based on the fully loaded capacities +50% of proposed systems / equipment and the structure from which the systems / equipment is to be mounted. All support system hangers shall be spaced at intervals of not greater than those laid out in the services specific section of the specification and when fully loaded shall not deflect between supports. The Contractor shall consider all requirements when making selections and shall reduce spacing of supports as required but shall not increase spacings. Additional supports are to be provided at intersections and any changes in direction.
- 22.1.5 The Contractor shall provide details of all anchors and fixings for review by the Structural Engineers and shall allow for "pull-out" testing to verify selections based on site conditions.
- 22.1.6 The Mechanical Contractor shall carefully read the notes on the drawings and include for all associated costs in his tender.

## 22.2 Standards

22.2.1 The ventilation plant shall comply with the requirements of the following standards:

- BS 5720:1979: Code of Practice for mechanical ventilation and air conditioning in buildings.
- BS 5422 Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C.
- DSP DW/144:2016: Specification for sheet metal ductwork, low, medium and high pressure/ velocity systems.
- DSP DW/172:2018: Specification for Kitchen Ventilation Systems. (Incorporates addendum April 2020)
- BS 476: Part 24:1987 Fire Tests on Building Materials and Structures Method for determination of the fire resistance of ventilation ducts.
- EN1366: Part 1 Fire Resistance Tests for Services Installations. Ventilation Ducts
- EN1366: Part 8 Fire Resistance Tests for Services Installations. Smoke Extraction Ducts
- EN1366: Part 9 Fire Resistance Tests for Services Installations. Single Compartment Smoke Extraction Ducts
- I.S. EN 1505:1998: Ventilation for buildings - Sheet metal air ducts and fittings with rectangular cross section - dimensions.
- I.S. EN 1506:1998: Ventilation for buildings - Sheet metal air ducts and fittings with circular cross section - dimensions.
- BS EN 12236:2002: Ventilation for buildings - Ductwork hangers and supports - Requirements for strength.
- I.S. EN 1886:2007: Ventilation for Buildings - Air Handling Units - Mechanical Performance.
- BS EN ISO 16890-1:2016: Air filters for general ventilation. Technical specifications, requirements and classification system based upon particulate matter efficiency (ePM)
- BS EN ISO 16890-2:2016: Air filters for general ventilation. Measurement of fractional efficiency and air flow resistance

- BS EN ISO 16890-3:2016 Air filters for general ventilation. Determination of the gravimetric efficiency and the air flow resistance versus the mass of test dust captured.
- BS EN ISO 16890-4:2016 Air filters for general ventilation. Conditioning method to determine the minimum fractional test efficiency
- ISO 21925-1:2018: Fire Resistance Tests - Fire Dampers for Air Distribution Systems. Mechanical Dampers.
- BS 9999:2017: Fire safety in the design, management and use of buildings. Code of practice
- ISO 9001 Approved manufacturing process.
- UL 1046 Listed and NSF classified flame arrestors
- ASTM F2519-05 Mechanical filter grease removal efficiency (93% @ 5 micron and 98% @ 15 micron.
- ASTM 1704-09 Verified capture and containment efficiency.
- HACCP Food safe certification
- CE Certified control and electrical systems
- LPS 1263 Certified primary filters, as required by DW/172 clause 13.1, to ensure full DW/172 compliance.



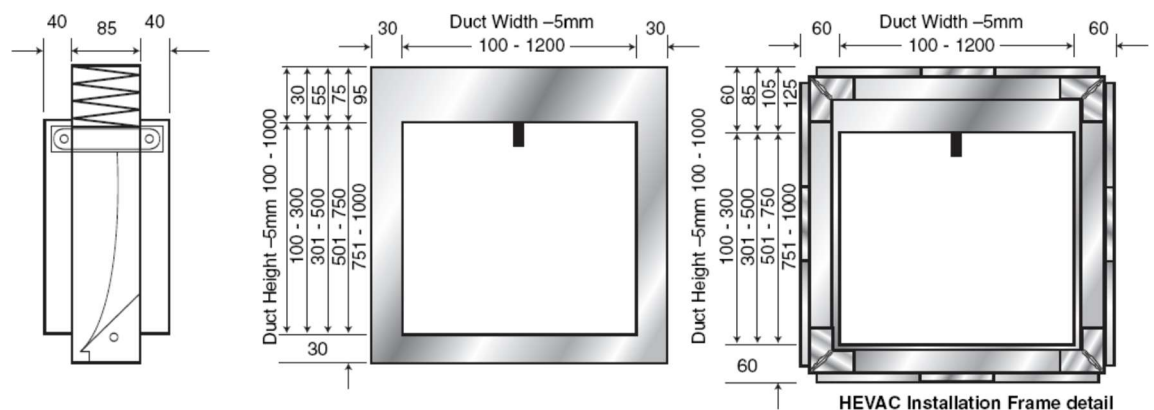
## 22.3 Equipment

### 22.3.1 Ductwork

- 22.3.2 Ductwork shall be constructed from hot-dip galvanised sheet steel and shall comply with HVCA DW144, specification for sheet metal ductwork.
- 22.3.3 The arrangement and size of all ductwork as required shall be as shown on IN2 Engineering Design Partnership drawings.
- 22.3.4 Ductwork bends shall be, where possible, equal radius type. Where mitre bends are necessary, turning vanes must be installed.
- 22.3.5 Where ductwork is exposed externally on the roof or in internal areas where there is a risk of condensation, mechanical or weather damage to the insulation, the ductwork shall be fully insulated to EN 14303 and clad to protect against environmental conditions as detailed in Section 4.12.9 of the client works requirements.
- 22.3.6 All external ductwork shall be supported via a non-penetrative, free-standing support system consisting of metal frames and support bases. The support system shall be designed to account for roof structure and type, wind and weight loading and future access requirements for roof replacement or service and maintenance modifications. Walkways, stepovers and access platforms shall be included to provide safe working access as necessary. Where required, pipe and cable entry in flat roof areas shall be installed using a fully weathered pre-fabricated penetration upstand system incorporating pipe/cable port plate with knock-out holes to accommodate services and removable lid for ease of future access.
- 22.3.7 All supply ductwork shall be fully insulated.
- 22.3.8 All extract ductwork used for heat recovery shall also be fully insulated.
- 22.3.9 Contractor shall provide duct stiffeners to strengthen the ductwork and prevent noise vibration for all ductwork exceeding a duct aspect ratio of 3:1.
- 22.3.10 Contractor shall carry out deep clean on all ductwork installations (i.e. supply, extract, intake and exhaust and dirty extract) prior to initial testing and commissioning taking place. Cleaning will be carried out in compliance with B&ES (formerly HVCA) TR19 - Guide to Good Practice - Internal Cleanliness of Ventilation Systems.
- 22.3.11 Mechanical ventilation ductwork with an air volume in excess of 1m<sup>3</sup>/s within the building shall be constructed and installed to medium pressure Class B in accordance with DW144 to minimise air leakage. 10% of the installed ductwork shall be selected at random and must be pressure tested to Class B leakage in accordance with DW144 and DW143.
- 22.3.12 Ductwork - Flexible
- 22.3.13 Flexible ducting shall be used to connect the circular ductwork to each grille, fan and any other ventilation unit.
- 22.3.14 Flexible ducting shall have 25mm acoustic insulation and be installed to maximum length to maximise acoustic insulation properties.
- 22.3.15 Flexible ductwork shall be installed between all items of equipment and rigid ductwork, such as grilles and diffusers. Flexible duct connections shall be kept to a **maximum length of 500mm** and will not be used for directional changes.
- 22.3.16 All flexible ductwork shall be 'semi-rigid' type, manufactured from aluminium, to allow for flexibility in both the axial and lateral planes.

- 22.3.17 All flexible ductwork shall be manufactured from a corrugated strip spirally wound to produce a tube with a double overlapped joint which is crimped to ensure pressure tightness up to 2500 Pa. and prevent uncoiling in use. The corrugated depth shall be designed to combine maximum flexibility with resistance to physical damage under site conditions.
- 22.3.18 All flexible ductwork shall have an operating temperature range of -30°C to +200°C and a max air velocity of 30m/s.
- 22.3.19 Contractor shall ensure that all flexible ductwork has been tested to BS476 parts 6, 7 and 20 and meets the requirements of CP413 section A2.2.3. (Ducts for Building Services) and is suitable for use throughout the U.K. Be tested to BS476 part 7 for a class 1 spread of flame. Be tested under the conditions laid down in BS476 part 20, to ensure flexible ductwork maintains its integrity for in excess of 15 minutes.
- 22.3.20 During fire conditions the metal composition of the flexible ductwork should ensure negligible smoke generation.
- 22.3.21 Ductwork - Insulation
- 22.3.22 All supply air and return air ductwork shall be insulated with glass fibre mattress insulation. The ductwork shall be supplied with a factory applied facing of reinforced aluminium foil incorporating self-adhesive overlap for fixing.
- 22.3.23 The mineral wool insulation shall be non-combustible. The aluminium foil covering shall be rated British Standard 'Class O' and Euro Class B in accordance with the Building Regulations Part B.
- 22.3.24 Insulation to ductwork shall be in accordance with standards specified in BS 5422 : 2009 and should effectively limit heat loss or heat gain.
- 22.3.25 The aluminium foil covering shall achieve a maximum vapour permeance of 0.00024g/s.MN. The insulation shall achieve a thermal conductivity of 0.035W/m.K and a thickness of 50mm to achieve a minimum Thermal resistance of 1.43m²K/W.
- 22.3.26 All ductwork installed externally shall be clad. Cladding shall be not less than 0.8mm aluminium sheeting or stucco embossed profile cladding.
- 22.3.27 Volume Control Dampers
- 22.3.28 The volume control dampers shall be opposed blade type and have unidirectional Aerofoil section blades capable of being rotated through 360° to allow airflow in either direction through the damper.
- 22.3.29 Dampers shall have stepped locking arrangement and blade position/ direction indicators. When the handle is locked, the damper blades shall be held rigidly in the airstream without play.
- 22.3.30 Non-return backdraught dampers shall be provide on all mechanical ventilation ductwork up to a diameter of 150mm. Motorised shut-off dampers which shall operate to close when the fan is not in use, shall be provided on all larger ducts.
- 22.3.31 Fire Dampers
- 20.3.31.1 All fire dampers shall be rated to 2 hours and be flanged to match the ductwork sizes to which they are fitted.
- 20.3.31.2 All fire dampers shall be installed complete with LED status indicators to provide a visual indication of fire damper status without the requirement to access the ductwork or ceiling.

- 22.3.32 The fire dampers shall be manufactured from corrosion resistant galvanised steel and incorporate spring loaded fusible link, with blades outside the air stream. Fusible link mechanism to activate at a temperature of 72°C.
- 22.3.33 All fusible link alloy shall be manufactured to BS 219.
- 22.3.34 All fusible link brackets shall be manufactured from grade 430 stainless steel as BS 1449 Part 2 1983
- 22.3.35 All fire dampers shall operate with blades "out of Airstream".
- 22.3.36 All fire damper casings shall conform to the following dimensions:



- 22.3.37
- 22.3.38 All fire damper frames shall be capable of expansion without distorting or exerting severe pressures within the surrounding structure.
- 22.3.39 Fire / Smoke Actuated Dampers (FSD)
- 22.3.40 Fire/smoke dampers shall be provided in all locations where mechanical ventilation ductwork passes through all fire rated barriers. All fire/smoke dampers shall comply with EN 15620:2010 and have been successfully tested to EN 1366-2.
- 22.3.41 The dampers shall be leak tested to comply with EN 1751 Class 2 and EN 1751, Class C. The fire smoke damper system shall be The system and equipment tested and approved to BS ISO 10294-1: 1996, BS EN 1366-2: 1999 and BS 476 pt. 20: 1987 Fire and Test Standards.
- 22.3.42 The dampers shall be linked to a central control and monitoring panel that is connected to the BEMS and Fire Alarm systems.
- 22.3.43 Dampers shall be accessible and ductwork on either side shall be adequately supported.
- 22.3.44 The Fire/smoke actuated dampers shall be controlled and monitored by a microprocessor-based system fully compliant with BS5588, BS476, ISO 10294-1, EN 1366-2 and all other relevant standards.
- 22.3.45 The Fire/smoke Damper System shall consists of a 12 inch embedded panel controller, UPS and pre-loaded software.

- 22.3.46 The Fire/smoke Damper Control System is a completely modular and flexible computerised system which operates and continually monitors the building's Fire / Smoke Dampers. The System will control and monitor up to 120 dampers and be Lonworks based. Each Damper graphically represented in the open, closed, travelling or fault state. Remote damper override via touch screen control panel. Inputs and outputs to and from the system via the DI8O4 I / O devices, each providing 8 off inputs and 4 off outputs to / from the panel PC. Software based zoning and grouping of devices allows multiple "cause and effect" schedules to be programmed.
- 22.3.47 Bespoke LED Mimic Panels to be provided as indicated on IN2 Engineering Design Partnership Drawings
- 22.3.48 Bespoke key switch or push button Firefighter's Override Panels (FOP) to be provided as indicated on IN2 Engineering Design Partnership Drawings.
- 22.3.49 A Fire/smoke damper interface shall be installed adjacent to each damper actuator. The SFDI device provides actuator power, interprets actuator auxiliary switch position and communicates over the network cable to the system panel.
- 22.3.50 The operation of the smoke damper control system fully integrated with the fire alarm system to ensure the correct cause and effect interaction. The system shall have a link to the BMS for 'fault' reporting.
- 22.3.51 The following network cable types shall be used:
- Piirelli FP200 Gold - 1.5mm - From system panel to Fire Alarm Interface.
  - Belden 8471 HN - 1.3mm - network cabling.
  - These cable specifications are fundamental to the stable and reliable operation of the system. If wired as a loop, the network polarity is sensitive. Each cable segment wired in a "daisy chain" i.e. in and out and no stubs allowed. All

Cabling to be installed & specified to fire / smoke damper manufacturers recommendations.

- The Fire/smoke actuated dampers shall have the following functions:
- Three levels of alarm priority.
- Panel PC driven system with real-time graphic displays. Panel PC to utilise solid state technology for optimum reliability. Full configuration and diagnostics from Panel PC.
- Optional automatic scheduled Damper testing.
- Multiple wiring configurations to include Radial or Loop Topology.
- Damper operational count to be provided.
- Flexibility to accommodate any last minute changes to strategy, zones, damper quantities, references and descriptions etc.
- Flexible functionality to enable standardisation of software (no bespoke site specific versions).
- System to be capable for multiple Cause and Effect scenarios (Cause and Effect strategy to be confirmed later).
- System to be capable of monitoring dampers, individually or by group or zone (zone output contacts to be triggered when a predefined percentage within a group or zone change position).
- System designed to cater for environmental occupancy as well as the building's smoke/fire strategy. RS232 BMS link to enable BMS to link directly to the system to read damper positions etc.
- Optional remote access available.
- Graphical User Interface displays live damper status and details as well as cause and effect strategies. Text fields facilitate clear description of device

references and locations. System wide activity logged and viewable for diagnostics and maintenance.

- System shall allow for phased commissioning and future expansion.
- System shall utilise smart technology to manage network traffic.
- System to be CE marked, LPCB, LVD and EMC compliant.
- Local manual damper operation via key mechanism.
- Software to be Open protocol to support others and future proof lifecycle maintenance costs.

22.3.52 Roof Cows

22.3.53 The contractor shall provide roof cows where indicated on drawings. Roof cows shall be manufactured from anodised aluminium powder coated to a non-standard RAL colour. The contractor shall verify the RAL colour with the architect prior to order.

22.3.54 All roof cows shall be provided c/w all necessary weather skirts, fixings etc. and free-issued to the main contractor for mounting within the roof.

22.3.55 All Plate heat exchangers shall come complete with a modulating, motorised, by-pass damper as standard.

22.3.56 Shut-off Dampers. The dampers shall be constructed from peraluman which is marine grade aluminium complete with 150mm high double skin blades. The blades shall be rotated by solid steel bar linkage mechanism attached to the blade shaft. Plastic or polymer-based linkages or gears shall not be permitted. The dampers shall comply with the requirements of EN1751 Class 4.

- removal of the motors. The motor shall be sized in order to provide 60% extra spare capacity on the design pressure and airflow.
- The motors in all fans are fitted with high temperature automatic cut-out protection.
- All fans motors shall come complete with variable speed drives. All fans shall be capable of operating 'constant pressure'.
- All motors shall be provided with mains control and isolation, with auxiliary contacts to be wired back to the control panel by the site electrical contractor for interlocking with the fan starter.

## 22.4 Construction Products Regulations

- 22.4.1 All products, materials and equipment used on this project shall comply with the Construction Products Regulations. All Construction Products covered by harmonised European Standards must carry a CE mark. The EU Construction Products Regulation (No. 305/2011 - CPR) shall apply in full to all products and materials proposed for use on this project.
- All products where applicable must comply with relevant Harmonised European Standards (hENs)
- 22.4.2 All products must be provided with a Declaration of Performance (DoP). The DoP must be provided by the manufacturers and must provide information relating to the characteristics of the product and confirm the conformity of the construction product with the declared performance. The CE mark attributed to the product must follow the DoP.
- 22.4.3 All technical submittals for products and equipment proposed by the Contractor must include all relevant DoP's, and must in the first instance be verified by the Contractor before submitting to the Employers Representative or Engineer. The Contractor must verify that the products being proposed do comply with the DoP and are suitable for their intended use in construction works and suitable for the application intended. The Contractor must also refer to National Standards to ensure that any National minimum standards for specific intended uses of the product in Ireland are complied with. Where such verifications and a DoP has not been provided as part of the technical submittal, the submittal will be deemed invalid and will not be considered. No claims for time lost, or cost increases owing to a potential change in the products or materials shall be considered by the Engineer or Employers Representative as a result.
- 22.4.4 The Contractor as part of his "Ancillary Certifiers" role under Building Control Amendment Regulations (BCAR), shall maintain a record of all DoP's and shall include same as part of his Inspection Plan records and reports.
- 22.4.5 The manufacturer's must fully comply with their obligations under the Construction Product Regulations, and shall if requested provide any additional, or supplementary information as may be requested by the Engineer or Employers Representative as may be considered necessary. In the event of such information not being forthcoming within a timely manner the Contractors proposal shall be rejected. No claims for time lost, or cost increases owing to a potential change in the products or materials shall be considered by the Engineer or Employers Representative as a result.
- 22.4.6 The Contractor must ensure compliance with Building Regulations and as such, all works must be carried out using proper materials that are fit for the use for which they are intended and for the conditions in which they are to be used.
- 22.4.7 The Contractor shall refer to the details within the Construction Products Regulation (CPR), and all annex's therein and shall ensure that all related elements are fully satisfied.

## 22.5 Samples & Technical Submittals

- 22.5.1 In advance of orders being placed for any equipment the contractor shall submit a full technical submittal including specific details of equipment dimensions, operational data, rated power, controls and wiring diagrams, materials specification.
- 22.5.2 The contractor shall include for the provision of 1 No. sample of each item as detailed. Samples to be erected and displayed for design team approval.
- 22.5.3 The contractor shall be responsible for determining quantities from IN2 Engineering Design Partnership drawings and specifications.
- 22.5.4 The contractor shall liaise with the various specialist suppliers to ensure that all necessary fixings kits, supports, connections, etc. are included.
- 22.5.5 The contractor shall refer to IN2 Engineering Mechanical Specification, Section M00 General Specification, part 00.4 "Production of Information - Procurement Details".
- 22.5.6 The contractor shall refer to IN2 Engineering Mechanical Contract Particulars, Section 2.5 Submittal of Alternatives & Section 2.7 Value Engineering.
- 22.5.7 All technical submittals shall be issued in the following format.
- A full index of items, date & revision number of submittal shall be included on the submittal title page.
  - All manufacturers / Suppliers schedules shall refer to IN2 item references.
  - Sections of IN2 specification relevant to the submittal, shall be returned from the manufacturers / Suppliers with each line item labelled by supplier / manufacturer as follows:
  - "Manufacturer / Supplier Initial" & "Compliant" or "Non-Compliant".
  - Should a line item prove non-compliant to spec, the manufacturer / supplier shall include details of proposed alternative.
  - Expected lead-in times shall be included for all items.
  - Where applicable contractor shall propose date for reviewing / approving samples on site.
  - Individual submittals shall be limited to related items of plant/equipment; to prevent re-submission of part-submittals under the same reference, should some items be rejected.

## 22.6 Approved Manufacturers and Vendors

- 22.6.1 The following manufacturers may be considered for the provision of the fire dampers and all components.
- Mech-Elec, as supplied by Mech-Elec or equal and approved.
  - Safeguard Systems, as supplied by safeguard or equal and approved.
  - SAFE4, as supplied by Air Force H&V Ltd, or equal and approved.
- 22.6.2 The following manufacturers may be considered for the provision of the Kitchen Canopies and all components.
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- 
- 22.6.3 The following manufacturers may be considered for the provision of the volume control dampers and all components.
- Mech-Elec, as supplied by Mech-Elec or equal and approved.
- 22.6.4 The following manufacturers may be considered for the provision of the Fire/smoke actuated dampers and all components.
- Safegard Systems, as supplied by safeguard or equal and approved.
- 22.6.5 Alternative products / systems will be considered if the contractor can demonstrate that the proposed alternative is equivalent to that specified in all of the following criteria: dimensions, performance, durability, materials, workmanship, quality, service life and aesthetics. Such alternative products / systems will be included in the works only after Employer Representative determination and written Employer Representative 'approval', which may be refused.

## 22.7 Installation

- 22.7.1 The arrangement and size of all ductwork and fittings as required shall be as shown as indicated on IN2 Engineering Design Partnership M20 series drawings and where necessary, as agreed with the Engineers on site.
- 22.7.2 All final electrical connections (where applicable) to be made by supplier at expense of mechanical contractor. All connections to be certified as Sub-System using separate Sub-System Completion Certificate. These certificates together with the relevant Test Record Sheets must be submitted to the Project Supervisor for inclusion in Project Safety Manual. Details such as Sub-System Completion Certificate numbers and Sub-System description should be recorded in the comment section of the certificate covering the entire installation.
- 22.7.3 Ductwork
- 22.7.4 All ductwork systems must be carried out by approved Contractors regularly engaged in similar work. The Mechanical Contractor must specify the Ductwork Sub-Contractor prior to commencement on site.
- 22.7.5 All Fire Rated and Fire Smoke Rated ductwork to be installed by specialist contractor with third-party certification, such as Firas, as identified in ASFP TGD 18.
- 22.7.6 All open ends of ductwork must be sealed during construction to prevent ingress of builder's debris.
- 22.7.7 It shall be the responsibility of the Mechanical Contractor to ensure that all supports are adequate, firmly and truly fixed and that they do not promote vibration. A strip of anti-vibration material between each support and ductwork shall be installed.
- 22.7.8 Brackets or supports shall be set out so that they do not obstruct the access to dampers or other fittings requiring maintenance.
- 22.7.9 Ductwork - Flexible
- 22.7.10 All flexible ductwork shall be cut to the required length while in its compressed state (ducting extends to approximately 4 times its compressed length).
- 22.7.11 All joints shall be sealed on medium and high pressure applications using proprietary sealing System. Manufacturers recommended ancillaries, supports and sealing systems shall be used at all times.
- 22.7.12 All flexible ductwork shall be capable of forming a 1/2 Dia radius. Sharper diameters will not be deemed acceptable.
- 22.7.13 All flexible ductwork shall be supported to manufactures recommendations to prevent 'sagging'.
- 22.7.14 All flexible ductwork shall retain its minimum cross sectional area, whether bent, extended or compressed.
- 22.7.15 Ductwork - Insulation
- 22.7.16 All insulation fixing shall be in accordance with manufacturer's instructions, all insulation to be cut to fit, so that the top and bottom pieces overlap the sides and bonded to the ductwork with approved adhesive applied in bands 100mm wide at 300mm centres. All joints to be sealed with 100mm wide approved self-adhesive tape.
- 22.7.17 All, bends, tees and branches shall be insulated as specified for the main ductwork. All necessary mitred sections, transition pieces and tee pieces to be cut on site and neatly fitted to suit duct shape.

22.7.18 Volume Control Dampers

22.7.19 Each damper shall be located at a distance of at least three times the duct width from a main supply duct branch connection or bend.

22.7.20 In all locations, volume control dampers shall be installed so as clear access is available for commissioning purposes.

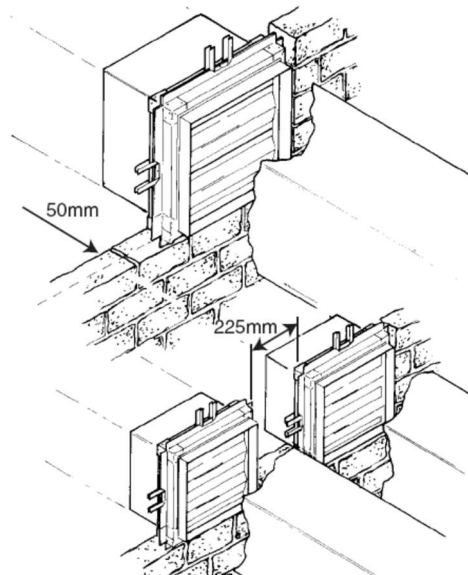
22.7.21 Fire Dampers & Fire / Smoke Actuated Dampers (FSD)

22.7.22 A properly sealed but easily removable access door shall be provided in the ductwork such as to allow straightforward access to the fusible link assembly. Access doors shall be removable and hinged. The contractor shall ensure that all access doors are in easily accessible positions with location as indicated on IN2 Engineering Design Partnership M20 series drawings.

22.7.23 The contractor shall issue fire damper & FSD's drawings co-ordinated with the fire certificate drawings. These co-ordination drawings shall clearly indicate all required fire dampers and access hatches and be submitted to the engineer and the architect for comment at least two weeks prior to the commencement of the ductwork installation.

22.7.24 The contractor shall be responsible for the co-ordination of all builders work requirements to facilitate the installation of both fire dampers, FSD's and access hatches.

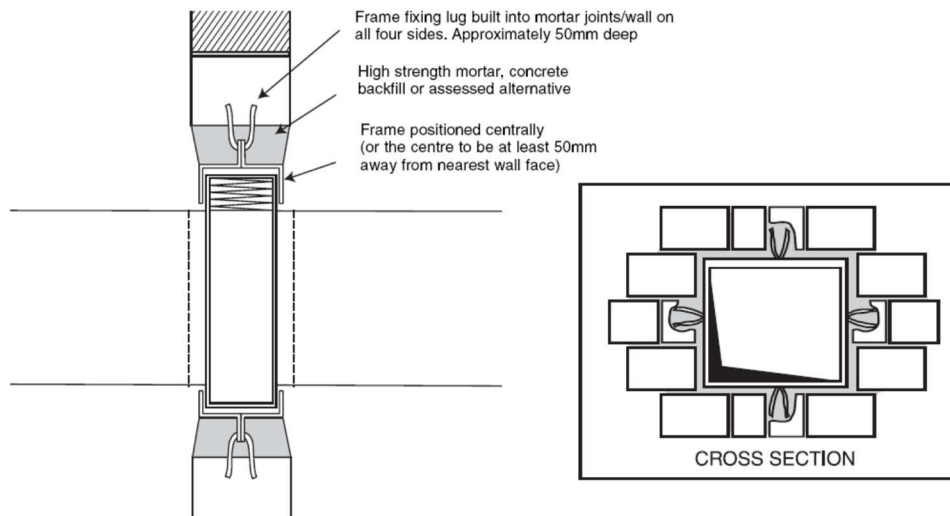
22.7.25 The fire damper & FSD frame should be installed centrally within the thickness of the surrounding wall or floor. Or, in the case of thick walls or floors, the centre line of the frame should be at least 50mm away from the nearest face.



22.7.26

22.7.27 Where more than one duct penetrates a wall or floor, adjacent fire damper & FSD assemblies should be separated by builder's work of a minimum thickness of 225mm.

22.7.28 All Fire dampers & FSD's to be installed in compliance with all relevant codes and standards, or as detailed below.



22.7.29

22.7.30

### 22.7.31 Roof Cowls

22.7.32 The contractor shall liaise with roof contractor to agreed weather details prior to commencement of works.

## 22.8 Testing & Commissioning

22.8.1 Air leakage tests for all ductwork shall be tested in accordance with HVCA: DW144: 1998. Testing shall be witnessed and completed prior to application of thermal insulation and cladding. In addition to complying with the leakage tests, the complete ductwork installation shall have no audible leaks. Where audible leaks are detected, the Contractor shall rectify the problem at their own expense.

22.8.2 All Fire Dampers & Smoke/Fire Dampers shall be certified by the contractor and the manufacturer.

## 22.9 Labelling

22.9.1 All fire dampers and smoke/fire dampers locations shall be clearly identified.

22.9.2 All ductwork shall be identified in accordance with HVCA: DW144: 1998, Appendix B.

## 22.10 Documentation

- 22.10.1 Upon project completion the contractor shall provide complete Operation and Maintenance instructions with "As installed" drawings.
- 22.10.2 The contractor shall provide the following documentation for all ventilation installations;
- Complete ductwork pressure test results indicating:
  - Date of test
  - Test pressure
  - Duration of test
  - Signatures of the contractors witness and engineers representative witness.
  - Complete Fire damper and/or smoke/fire damper certification indicating:
  - Date of test
  - Certification
  - Signatures of the contractors witness and engineers representative witness.
  - Complete commissioning results indicating:
  - Date of commissioning
  - Design flowrates and pressure drops
  - Commissioned flowrates and pressure drops
  - Full spectrum noise data in selected areas as requested by the Engineer:
  - Date of test
  - Design noise rating
  - Commissioned noise rating
  - Complete Dishwasher canopy certification indicating:
  - Date of test
  - Certification
  - Signatures of the contractors witness and engineer's representative witness.
  - Date of test
  - Certification
  - Signatures of the contractors witness and engineer's representative witness.

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## 70.1 Outline Description

- 70.1.1 The Contractor shall include for the complete Building Automation and Controls installation, including the provision of all devices and items of equipment as detailed on the drawings or as required to implement the scheme in its entirety to the intent of the design as outlined in the contract documents. The Contractor shall be responsible for all additional equipment incidental to specific control system requirements which are required but may not be referenced within the specification or described on contract drawings.
- 70.1.2 The Contractor shall engage a specialist Building Automation and Controls contractor and co-ordinate all elements of the installation in order to provide a complete system in accordance with the intent of this specification to the satisfaction of the engineer.
- 70.1.3 The Contractor shall carefully read the notes on all mechanical and electrical drawings and schematics and include for all associated costs in his tender.
- 70.1.4 The Contractor shall be responsible for all handling, storing, transportation to site, testing and commissioning and setting to work.
- 70.1.5 The Contractor shall be responsible for co-ordination between mechanical and electrical services installation with the respect advised of system requirements and the fitting of control system devices.
- 70.1.6 The Mechanical Contractor shall be responsible for the Design, Selection and installation of the complete support & Bracketry systems (inc Anit-Vib mounts, plinths, & proprietary support systems etc) including anchor systems and metal framing supports etc. The Contractor shall be responsible for determining the appropriate components, materials and methods of installation based on the fully loaded capacities +50% of proposed systems / equipment and the structure from which the systems / equipment is to be mounted. All support system hangers shall be spaced at intervals of not greater than those laid out in the services specific section of the specification and when fully loaded shall not deflect between supports. The Contractor shall consider all requirements when making selections and shall reduce spacing of supports as required but shall not increase spacings. Additional supports are to be provided at intersections and any changes in direction.
- 70.1.7 The Contractor shall provide details of all anchors and fixings for review by the Structural Engineers and shall allow for "pull-out" testing to verify selections based on site conditions.
- 70.1.8 The location of all devices is to be indicated on drawings and submitted for design team approval at least 2 weeks in advance of proposed installation dates. The Contractor shall be responsible for co-ordination of the control system installations on site providing clear marking and labelling of the exact positions for devices to be fitted

## 70.2 Standards

- 70.2.1 All goods, products and materials shall be in accordance with the latest revision of Irish and EU Standards.
- 70.2.2 The complete installation shall comply with the latest codes and any other legal requirements applicable to any element of materials, equipment and services provided under this contract, even if an applicable code or legal requirement is not specifically referenced in the contract documents.
- 70.2.3 All equipment and installations shall comply with the current provisions of the following standards;
- European Union (EU)
  - EMC Directive 89/336/EEC
  - Electromagnetic Compatibility Requirements
  - CENELEC
- 70.2.4 All electronic equipment and devices must have the CE mark of compliance. Any items without certification or compliance in this respect will not be permitted and shall be removed and replaced at the contractor's expense.
- 70.2.5 The system installation shall be in accordance with current ETCI Regulations.

## 70.3 Materials

- 70.3.1 All products, materials and equipment shall comply with the project specification, as well as referenced standards and all applicable regulatory requirements.
- 70.3.2 Similar items of equipment and individual materials shall be selected from one manufacturer's range to standardise appearance, maintenance and replacement.
- 70.3.3 Unless otherwise indicated standard manufacturer's finishes and colours are to be provided.
- 70.3.4 All materials, products and equipment is to be transported, handled, lifted, hoisted and stored in accordance with the manufacturers guidelines to prevent damage to equipment and injury to persons.

## 70.4 Samples

- 70.4.1 In advance of orders being placed or the installation of any items of equipment, the contractor shall provide samples to be displayed on site for review, comment or approval.
- 70.4.2 Any costs associated with the provision of samples must be included by the contractor.

## 70.5 Coordination

- 70.5.1 The Contractor shall note his responsibility for co-ordination of his works with other contractors and sub-contractors ensure all necessary works and attendances by the main contractor and other sub-contractors is advanced in the accordance with the expectations and requirements of the controls specialist to complete his works.



- 70.5.2 The Contractor shall co-ordinate plant space requirements with other services following locations shown on drawings utilising space efficiently to maximise accessibility for other installations and for future access and maintenance.
- 70.5.3 The Contractor shall review mechanical and electrical layouts with other contractors prior to any installation.
- 70.5.4 The Contractor shall ensure regular on site attendances of the controls specialist to verify all controls installations and the installations of associated mechanical and electrical services to ensure that all controls devices are installed in their correct and optimum locations. Failure to do so may result in adverse effects to the main contractors programme and finishes, the costs of which may be directed to the responsible Contractor.
- 70.5.5 The Contractor will make available the appropriate qualified personnel for attendance at regular site co-ordination meetings.

## 70.6 Quality Control and Workmanship

- 70.6.1 The Contractor shall be responsible for on-site installation quality control. As such he will implement and maintain high standards of quality control governing materials and equipment, project management, site conditions and workmanship to provide a complete working installation to the highest standards that can be reasonably expected or attained.
- 70.6.2 Only persons suitably trained with the necessary qualifications and experience appropriate to the task shall carry out works associated with the control system installations.
- 70.6.3 The Contractor shall execute his works in accordance with industry standards, best practice and any relevant guidelines offered by codes of practice or applicable regulations.
- 70.6.4 The Contractor shall establish and implement manufacturer's installation instructions and procedures in full.
- 70.6.5 The Consulting engineer or his representative reserves the right to observe ongoing and completed work and comment there on without prejudice to the contractor's responsibility for quality control.
- 70.6.6 Defective or sub-standard installations or workmanship shall be rectified at the expense of the contractor

## 70.7 Testing & Inspections

- 70.7.1 The Contractor and controls specialist shall be responsible for carrying out all commissioning testing and inspections as required by the specification or by any governing regulations or codes of practice not referenced in the specifications.
- 70.7.2 The controls specialist shall maintain an accurate documented record of all commissioning and test results to include the type of test carried out listing all observations and findings including defects and failures. The documentation shall also give details of proposed or instructed remedial actions taken to correct any defects or failures. A retest of all failures shall be documented.

- 70.7.3 The controls specialist through the Contractor shall prepare a written schedule giving a minimum 10 day notice period of proposed test dates for witnessing by the consulting engineer or his representative. Once the entire system has been commissioned, the contractor shall offer the system for witness testing by the Engineer giving at least 1 weeks advance notice. The contractor shall expect that the entire system including any sub-systems will be witnessed on a point by point basis.
- 70.7.4 The Contractor shall provide the original Test and Compliance Certificates for inclusion in the O&M Manual. These certificates must be presented no later than Practical Completion Stage, as failure to do so will delay practical completion and all costs for delays attributable will be borne by the contractor.
- 70.7.5 On completion of system installation full testing and commissioning is to be carried out in line with CIBSE and BSRIA guidelines and current ETCI Regulations.

## 70.8 Documentation

- 70.8.1 In advance of any works being undertaken the controls specialist must provide a complete technical submittal of the proposed works to consist of but not be limited to the following;
- Functional Description of Operation outlining the complete control strategies and control attributes for each plant or subsystem.
  - Points list of all hardware and software assigned points.
  - Full technical data sheets and details of all devices and components proposed for use on the project.
  - Project management and installation plan.
- 70.8.2 Upon project completion the controls specialist will provide complete Operation and Maintenance instructions with as installed drawings.
- 70.8.3 The Contractor within his tender return must submit an outline technical proposal giving details of controllers and other principle elements proposed for use on this project. An outline points list is also to be included. Failure to submit these details shall invalidate the tender submittal.

## 70.9 Operation and Maintenance Manuals

- 70.9.1 In advance of practical completion the controls specialist shall supply a complete set of Operation and Maintenance Manuals to the Consulting Engineer for comment.
- 70.9.2 Following receipt and inclusion of comments the contractor will present 3 copies of the approved Operation and Maintenance Manual to form part of the health and safety file.
- 70.9.3 The Operation and Maintenance Manual shall include the following as a minimum;
- As Installed Drawings
  - Functional Description of operation for the entire system's
  - Original copies of all installed software together with a back-up of the commissioned system data.
  - Technical Data on all installed systems and components

- Operation and Maintenance requirements for all installed systems and components.
- Contact Names and Details for relevant parties
- Proposals for Maintenance including a schedule of visits as proposed for the maintenance period.

## 70.10 Handover

- 70.10.1 The Contractor and Controls Specialist shall be available for attendance at a formal handover and presentation of the O&M Manuals to the client and a date and time to be advised by the consulting engineer. The controls specialist will be expected to demonstrate a working understanding of the installed systems to a level that can be conveyed to the client to enable him to operate the systems and installations to their full potential with confidence.
- 70.10.2 Post Handover and for an initial "run-in" period following occupation of no less than 2 weeks the Contractor and controls specialist shall maintain an on-site presence of appropriate persons to ensure the seamless transition for the new occupants.
- 70.10.3 Following handover the Contractor shall attend monthly review meetings on site to deal with any arising issues and ensure identified "snag" items are being actioned.

## 70.11 Testing

- 70.11.1 The contractor shall include for the provision of operator training on the installed system. The training shall consist of 3 days, 2 days training to be given immediately after handover with the further 1 days training to be given at the clients request but allowing for reasonable time for familiarisation with the system

## 70.12 Maintenance Period

- 70.12.1 The Contractor shall maintain the Building Automation and Controls System Installation for a period of twelve (12 No.) calendar months from the date of issue of a certificate of practical completion by the Architect.
- 70.12.2 The Contractor shall include for quarterly visits, each of two days duration during the maintenance period. Such visits shall include for checking the operation of plant, equipment, accessories etc., calibration, making all necessary adjustments and carrying out all necessary replacement of any such faulty component, incidental to this Contract.
- 70.12.3 All visits shall be scheduled to occur at times suitable to the client. Each visit shall be expected to consist of an 8hr working day exclusive of any travel time. Site attendance records shall be maintained by the contractor, signed by the Client and submitted to the Engineers.
- 70.12.4 In addition to on-site service and maintenance visits the controls specialist shall provide an off-site monitoring service for the period of twelve calendar months from the date of handover, to provide remote assistance to the building operator in the proper management of the control system.

- 70.12.5 The Contractor shall also provide an Emergency Service during the whole of the Maintenance Period. Rates for emergency call-outs are to be documented in the proposals for maintenance issued as part of the O&M.

## 70.13 Defects liability

- 70.13.1 During the Maintenance period any defect developing in the Building Automation and Controls System Installations during this period shall be rectified and made good at the Contractor's own expense. Exceptions will only be made where it is evident that the cause can be seen to be outside the Contractors control. The term defect in shall be interpreted as:
- 'any item of plant, equipment or component thereof, accessory or fitting that shall be found defective, show signs of mechanical or electrical weakness or undue wear in consequence of faulty design, workmanship or material'.
- 70.13.2 In the event of the Contractor refusing to rectify such defects within a reasonable period, the Engineers will have the works carried out by others, and any charges arising there from shall be at the expense of the Contractor and deductible from retention monies.
- 70.13.3 Defective materials or components shall be replaced from new stock supplied by the contractor. The use of site retained spare parts shall not be permitted as permanent replacement of defective equipment.

## 70.14 Commissioning

- 70.14.1 The Contractor and Controls Specialist shall participate in the preparation of the project commissioning programme and shall provide a detailed programme of commissioning activities and time resources required to complete the entire installations.
- 70.14.2 It is the expectation that all commissioning will be complete and test records submitted at practical completion.
- 70.14.3 The Contractor and controls specialist shall commit adequate resources commensurate to the scale of the project and the commissioning programme to ensure that the system is completely and effectively commissioned at the time of handover.
- 70.14.4 The controls specialist shall ensure daily site attendance during the commissioning phase and for the first week following handover.
- 70.14.5 As elements of the commissioning relates to the natural ventilation systems it is fully expected that the controls specialist shall have fully commissioned the entire system and shall be able to demonstrate its operation from trend logs as well as point to point checks.
- 70.14.6 As conditions for normal operation of the system would vary across both winter and summer periods it is a strict requirement that the controls specialist provides two stages of commissioning and demonstrations of the system.
- 70.14.7 Stage 1:

- 70.14.8 Stage 1, being the initial commissioning and verification of the operation of the field devices and “bench testing” the software. The objective at this stage is that the Contractor shall fully demonstrate the operation of the complete system to ensure that when the conditions prevail that the system will operate.
- 70.14.9 To achieve this it is expected by the Engineer that the controls specialist would be able to manipulate the system by changing setpoints and sensor values to “force” the outputs of the BMS to drive the windows to the open position. We would also expect that the overrides for wind, rain, fire etc could then be demonstrated and the results witnessed.
- 70.14.10 Note, simple operation of the relays would not be accepted as adequate proof of operation.
- 70.14.11 The Engineer would also expect the controls specialist to demonstrate the effective operation of the sensors and also demonstrate the accuracy of same.
- 70.14.12 To conclude stage 1 the Engineer would also expect the Contractor as controls specialist to commence trend logging of the natural ventilation control points to include the following.
- 70.14.13 Outside air temperature reference
- 70.14.14 Wind speed / direction reference
- 70.14.15 Internal temp. reference
- 70.14.16 Window Open / Close signal reference (for each zone)
- 70.14.17 These trend graphs would be required to be logged permanently for ongoing review and monitoring of the system performance.
- 70.14.18 Stage 2:
- 70.14.19 Stage 2 of the process should occur when the building is occupied and during the next season whereby the internal and external temperatures reach levels where the natural ventilation system will be expected to operate. It is required that trend graphs for each floor plate are provided to the Engineer for review and for the contractors to be satisfied that the system components are operating as they should.
- 70.14.20 Note: Diligent thorough commissioning of the Building Automation and Control System is an absolute requirement. The Controls Specialist shall ensure adequate resources are applied and that all such costs are included.

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## 71.1 Outline Description

- 71.1.1 The following descriptions illustrate the design intent and the basis of control and operation of principal elements of the Building Automation and Control system.
- 71.1.2 The controls specialist shall be responsible for the development of a complete functional operational strategy for all elements of the BMS installation to be submitted to the engineer for comment or approval in advance of commencement of any works.
- 71.1.3 A differential pressure switch shall be piped across each pump and shall report the pump status to the BAS.
- 71.1.4 All inverter speed controllers shall report inverter frequency to BMS.
- 71.1.5 A differential pressure transducer shall be piped across each circuit and shall report possible strainer blockages or water leaks to the BAS.
- 71.1.6 If pressurisation unit failure is detected then the boilers shall immediately shutdown under BAS software control.
- 71.1.7 The controls specialist shall refer to CIBSE and BSRIA Application Guides in the development of the operational and control strategies.
- 71.1.8 Before taking to site the controls specialist shall present the control strategy software for bench testing or simulated operation at his or other agreed premises
- 71.1.9 The Contractor shall be responsible for the complete integration of the main building BMS and controls system with that of the existing BMS systems. Both systems must be share protocols and all information be represented in full graphics on the "front end" operators terminal.

## 71.2 Chiller Plant Operation

- 71.2.1 The replacement air cooled chiller shall be fully integrated into the existing Building Management System (BMS) and shall operate under automatic control in accordance with the existing time schedules, cooling demands and system enable signals.
- 71.2.2 The chiller shall be complete with integral variable speed primary circulation pumps arranged in a duty / standby configuration. The duty pump shall be automatically rotated weekly via the BMS to ensure even pump wear and resilience of operation.
- 71.2.3 The chiller shall operate to maintain a chilled water flow / return temperature regime of approximately 7°C / 12°C unless otherwise dictated by the manufacturer's controls or seasonal optimisation strategies.
- 71.2.4 The BMS shall monitor and display the following chiller operating parameters as a minimum:
  - Chiller run status
  - Common fault alarm
  - Chilled water flow temperature
  - Chilled water return temperature
  - Pump run status
  - Pump duty / standby status

- Pump fault status
  - Inverter speed / frequency indication
  - Chiller enable status
- 71.2.5 A differential pressure switch or flow proving device associated with each integral circulation pump shall report pump status and flow proof to the BMS.
- 71.2.6 All inverter speed controllers associated with the integral pumps shall report operating frequency and fault status to the BMS.
- 71.2.7 The replacement chiller controls shall interface fully with the existing BMS to allow remote enable / disable control, monitoring, alarm indication and adjustment of operating setpoints where permitted by the manufacturer.
- 71.2.8 In the event of a critical chiller fault, the chiller shall automatically shut down and initiate a fault alarm signal to the BMS. Where possible, the standby pump shall continue to operate subject to chiller manufacturer control philosophy.
- 71.2.9 Frost Protection
- 71.2.10 The replacement chiller shall include manufacturer's frost protection controls suitable for outdoor installation and operation during low ambient conditions.
- 71.2.11 When the chiller is disabled due to no cooling demand, the integral circulation pumps shall remain available for automatic frost protection operation in accordance with the manufacturer's control strategy.
- 71.2.12 Should the ambient air temperature fall below the manufacturer's frost protection setpoint, the circulation pumps shall automatically operate to maintain water movement through the evaporator and associated pipework.
- 71.2.13 The contractor shall ensure that all frost protection controls, trace heating requirements, glycol concentrations and low temperature safety interlocks are coordinated with the chiller manufacturer's recommendations and existing site standards.
- 71.2.14 Pump Operation
- 71.2.15 P.1.01/02 - Chiller Integral Primary Circulation Pumps shall be arranged in a duty / standby configuration integral to the replacement air cooled chiller unit and shall operate under the chiller manufacturer's controls in conjunction with the existing BMS.
- 71.2.16 Under normal operating conditions, one pump shall operate as the duty pump with the second pump remaining available as automatic standby. The duty pump shall be automatically rotated weekly via the BMS or chiller controls to ensure even operating hours.
- 71.2.17 The integral circulation pumps shall operate as variable speed pumps and shall modulate in response to system demand and differential pressure requirements as determined by the chiller control strategy.
- 71.2.18 A differential pressure switch and/or flow proving device shall be provided for each pump and shall report pump run status, flow status and fault indication to the BMS.
- 71.2.19 All pump inverter drives shall report operating frequency, run status and fault alarms to the BMS.
- 71.2.20 In the event of duty pump failure, the standby pump shall automatically start and a fault alarm shall be initiated at the BMS.



- 71.2.21 The circulation pumps shall continue to operate during frost protection mode as required by the chiller manufacturer's control philosophy to maintain water circulation through the evaporator and associated chilled water pipework.
- 71.2.22 Pump operation shall be interlocked with the chiller enable signal such that the chiller shall not operate unless flow is proven through the evaporator.

## 71.3 AHU Operation

- 71.3.1 The replacement supply Air Handling Unit and associated extract systems shall derive power from, and operate under, the control dictates of the associated MCC's and existing Building Management System (BMS).
- 71.3.2 The new ventilation system shall comprise:
- One replacement supply Air Handling Unit complete with run-around coil heat recovery system.
  - Two local extract systems connected to the run-around coil arrangement.
  - Four supply air branches serving the Radiology Department areas.
  - Existing Individual LTHW trim heater batteries serving each supply branch for local temperature control.
- 71.3.3 The AHU and associated extract systems shall operate under BMS time schedules and departmental enable signals. The supply and extract systems shall be fully integrated into the existing BMS for monitoring, control and alarm indication.
- 71.3.4 The supply and extract fans shall operate via variable speed drives to maintain the required airflow and duct static pressure conditions as determined during commissioning.
- 71.3.5 Supply and extract fan VSDs shall modulate to maintain constant pressure within the associated ductwork systems.
- 71.3.6 Supply and extract airflow rates shall be balanced and commissioned to suit the existing department ventilation requirements.
- 71.3.7 Existing extract systems shall remain operational with airflow regulation achieved via Variable Control Dampers (VCDs) installed within the extract ductwork.
- 71.3.8 The BAS shall monitor and display supply fan status, extract fan status, fan speed, inverter frequency and common fault alarms.
- 71.3.9 AHU and associated extract systems shall disable upon activation of the fire alarm system in accordance with the agreed fire strategy and shall automatically resume normal operation once the alarm condition has been cleared and reset.
- 71.3.10 The run-around coil heat recovery system shall operate to recover heat from the extract airstream and transfer this energy to the supply air system.
- 71.3.11 The run-around coil circulation pump shall operate whenever the supply and extract systems are enabled.
- 71.3.12 The run-around coil control valve shall modulate to maximise heat recovery while maintaining stable supply air temperature conditions.
- 71.3.13 The run-around coil circulation pump shall be interlocked with both supply and extract fan operation.
- 71.3.14 Failure of the run-around coil pump shall generate a BMS alarm.
- 71.3.15 The run-around coil system shall include air vents, drain points and balancing valves to facilitate commissioning and maintenance.
- 71.3.16 Each of the four supply air branches shall incorporate an individual LTHW trim heater battery complete with modulating control valve.

- 71.3.17 Each trim heater battery shall modulate independently to maintain the respective branch supply air temperature setpoint or associated room temperature condition as determined during commissioning.
- 71.3.18 Supply air temperature limits shall initially be set to a minimum of 18°C and maximum of 45°C unless otherwise required by the department operational requirements.
- 71.3.19 The BAS shall monitor and display all control functions, alarms and sensor values associated with the ventilation system including, but not limited to:
- Supply fan run status
  - Extract fan run status
  - Fan fault alarms
  - Filter dirty alarms
  - Supply air temperature
  - Extract air temperature
  - Run-around coil temperatures
  - LTHW trim battery valve positions
  - Duct pressure readings
  - VSD operating frequencies
  - Frost protection alarms
  - Common AHU fault alarm
- 71.3.20 In the event of a common fault alarm, the BAS shall raise an alarm at the operator workstation and trend the associated fault condition.
- 71.3.21 The ventilation systems shall be commissioned to maintain the existing room pressure relationships within the Radiology Department.
- 71.3.22 Supply and extract airflow quantities shall be adjustable via BMS and VCD arrangement to suit departmental balancing requirements.
- 71.3.23 Fire alarm interfaces and shutdown sequences shall be coordinated with Beaumont Hospital fire strategy requirements.
- 71.3.24 Any fire/smoke dampers associated with the modified ductwork systems shall be monitored by the BMS for status indication where applicable.
- 71.3.25 The contractor shall coordinate all shutdowns and changeover works with Beaumont Hospital representatives to minimise disruption to operational departments.

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## 72.1 Outline Description

- 72.1.1 The Contractor shall be responsible for the supply, commissioning and setting to work a complete system consisting of Heating and ventilation controls.
- 72.1.2 The Contractor shall engage a specialist Building Automation and Controls contractor and co-ordinate all elements of the installation in order to provide a complete system in accordance with the intent of this specification to the satisfaction of the engineer
- 72.1.3 The Contractor shall include for all necessary attendances and software configuration to ensure compatibility and seamless integration of the systems.
- 72.1.4 The Contractor shall be responsible for the Design, Selection and installation of the complete support & Bracketry systems (inc Anit-Vib mounts, plinths, & proprietary support systems etc) including anchor systems and metal framing supports etc. The Contractor shall be responsible for determining the appropriate components, materials and methods of installation based on the fully loaded capacities +50% of proposed systems / equipment and the structure from which the systems / equipment is to be mounted. All support system hangers shall be spaced at intervals of not greater than those laid out in the services specific section of the specification and when fully loaded shall not deflect between supports. The Contractor shall consider all requirements when making selections and shall reduce spacing of supports as required but shall not increase spacings. Additional supports are to be provided at intersections and any changes in direction.
- 72.1.5 The Contractor shall provide details of all anchors and fixings for review by the Structural Engineers and shall allow for "pull-out" testing to verify selections based on site conditions.
- 72.1.6 The Contractor shall be responsible for the complete integration of the main building BMS and controls system with that of the existing BMS systems. Both systems must be share protocols and all information be represented in full graphics on the "front end" operators terminal.

## 72.2 Standards

- 72.2.1 The Building Automation and Control System (BMS) provided is to be installed, tested and commissioned to ensure the system and its respective components are in accordance with industry best practice, CIBSE Guides and BSRIA Application Guides.
- 72.2.2 All devices and equipment shall conform to relevant EU or Irish standard and all devices are to carry the CE Mark of approval
- EMC Directive 89/336/EEC
  - Electromagnetic Compatibility Requirements
  - CENELEC
- 72.2.3 The system installation shall be in accordance with current ETCI Regulations

## 72.3 Equipment

- 72.3.1 All equipment including window actuators, power supply units, relays and addressable interfaces with the BMS are to be provided under this contract.
- 72.3.2 Power supply units shall be selected to meet the maximum load output and shall be suitable for mounting within service void locally to the windows being served.

## 72.4 Testing & Commissioning

- 72.4.1 The controls specialist shall include for the co-ordinated testing and commissioning of the complete installations between BMS and window system commissioning engineers. The controls specialist shall assume responsibility for the correct functioning of all final integrated systems, including the window systems. Prior to Building Handover, the systems shall be offered for demonstration of all functions to the client's representative.

## 72.5 Documentation

- 72.5.1 Full maintenance manuals and test certificates incorporating the window system shall be submitted to the Engineers at the practical completion stage.

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## 76.1 Outline Description

- 76.1.1 The Contractor shall be responsible for the supply, and commissioning of motor control centres and control outstations to be complete with the necessary starters, overloads, MCB's, and control components as necessary to provide a complete working installation. The MCC's shall be wall mounted within the boilerhouse and plant rooms.
- 76.1.2 The Mechanical Contractor shall be responsible for the Design, Selection and installation of the complete support & Bracketry systems (inc Anit-Vib mounts, plinths, & proprietary support systems etc) including anchor systems and metal framing supports etc. The Contractor shall be responsible for determining the appropriate components, materials and methods of installation based on the fully loaded capacities +50% of proposed systems / equipment and the structure from which the systems / equipment is to be mounted. All support system hangers shall be spaced at intervals of not greater than those laid out in the services specific section of the specification and when fully loaded shall not deflect between supports. The Contractor shall consider all requirements when making selections and shall reduce spacing of supports as required but shall not increase spacings. Additional supports are to be provided at intersections and any changes in direction.
- 76.1.3 The Contractor shall provide details of all anchors and fixings for review by the Structural Engineers and shall allow for "pull-out" testing to verify selections based on site conditions.



## 76.2 Standards

76.2.1 Motor control centres and outstations associated with this installation shall comply with the requirements of the following standards;

- BS EN 60947: Low-voltage switchgear and control gear
- BS EN 61439-1:2011 Low-voltage switchgear and control gear assemblies. General rules.
- 
- BS EN 61439-2:2011 Low-voltage switchgear and control gear assemblies. Power switchgear and control gear assemblies
- 
- BS EN 61439-5:2015 Low-voltage switchgear and control gear assemblies. Assemblies for power distribution in public networks
- 
- BS EN 60439-3:2012 Low-voltage switchgear and control gear assemblies. Distribution boards intended to be operated by ordinary persons (DBO)

## 76.3 Equipment

- 76.3.1 The motor control centre and outstation enclosures shall be Sheet Steel cubicle construction as manufactured by Logstrip or equal and approved and will be suitable for surface mounting and shall be constructed with the following;
- Motor Control Centres are to be suitable for operation on 400/230V 3phase 4 wire system with a prospective fault level of 35kA.
  - Motor Control Centres are to incorporate vertical cable management sections.
  - Motor Control Centres and outstations are to be suitable for top and bottom cable entry/exit.
  - Motor Control Centres and outstations are to be vermin proof.
  - Power sections and Control sections are to be segregated including the separation of their respective components and devices.
  - Klippon type terminals are to provide for all outgoing wireways
  - IP 31 rated enclosure.
  - references and locations. System wide activity logged and viewable for diagnostics and maintenance.
  - System shall allow for phased commissioning and future expansion.
  - System shall utilise smart technology to manage network traffic.
  - System to be CE marked, LPCB, LVD and EMC compliant.
  - Local manual damper operation via key mechanism.
  - Software to be Open protocol to support others and future proof lifecycle maintenance costs.

## 76.4 Approved Manufacturers & Vendors

- 76.4.1 The following power component manufacturers may be considered for the provision of all switchgear components.
- Merlin Gerin
  - ABB
  - Siemens
- 76.4.2 All equipment and ancillary components must be selected from the same manufacturers range.
- 76.4.3 The contractor must select an authorised Switchgear manufacturer for the assembly testing and provision of all switchgear. All controls switchgear associated with this project is to be provided by the same manufacturer using identical components.

## 76.5 Installations

- 76.5.1 The MCC shall be supplied by the controls specialist and shall be free -issued to the packaged plant room manufacturer for integration into the system to provide a complete working installation that can be tested and demonstrated before the plant room is delivered to site.
- 76.5.2 The manufacturer's must fully comply with their obligations under the Construction Product Regulations, and shall if requested provide any additional, or supplementary information as may be requested by the Engineer or Employers Representative as may be considered necessary. In the event of such information not being forthcoming within a timely manner the Contractors proposal shall be rejected. No claims for time lost, or cost increases owing to a potential change in the products or materials shall be considered by the Engineer or Employers Representative as a result.
- 76.5.3 The Contractor must ensure compliance with Building Regulations and as such, all works must be carried out using proper materials that are fit for the use for which they are intended and for the conditions in which they are to be used.
- 76.5.4 The Contractor shall refer to the details within the Construction Products Regulation (CPR), and all annex's therein and shall ensure that all related elements are fully satisfied.

## 76.6 Testing & Commissioning

- 76.6.1 Electrical systems testing and commissioning is to be carried out in accordance with current ETCI Regulations.
- 76.6.2 "Point to point" testing of all control points and signal cables shall be carried out by the controls specialist. Each point test shall be documented and shall be available for inspection by the Engineer upon request.

## 76.7 Documentation

- 76.7.1 Before delivery to site of any switchgear, the contractor must provide to the engineer a copy of the manufacturers test certificate for all MCC's and control panels. A minimum of 10 days' notice must be given prior to inviting the engineer to attend testing.
- 76.7.2 Upon completion of the project the contractor shall provide the following documentation;
- ETCI / RECI Test Certificates for the Motor Control centre and all outgoing circuits.
  - Circuit charts.