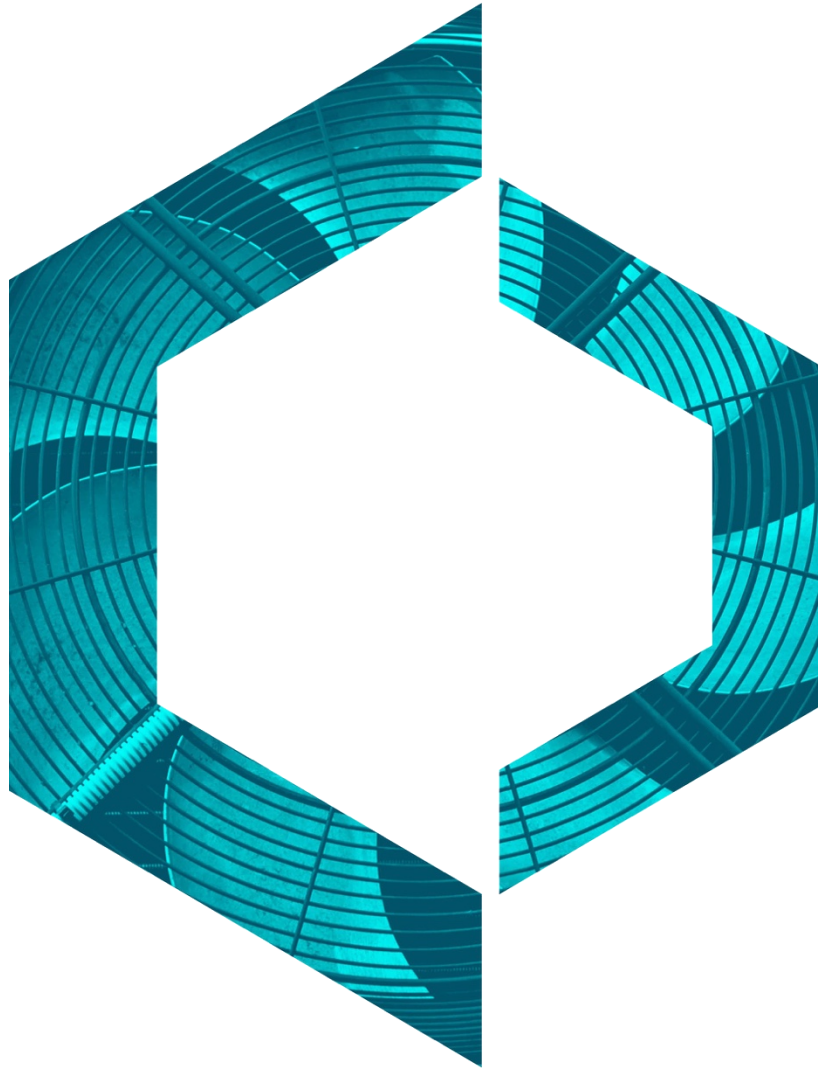




Seclusion Room Suite Roscommon University Hospital Co. Roscommon

Technical Specifications For the Mechanical Services Installation

Date	21/08/2026
Report Revision	00
IN2 Project Ref:	A2622
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Client



Specifications Register – Mechanical Services

Project Name Seclusion Room Suite Roscommon University Hospital
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Section	Specification	Rev	Date	Issue
M00	General Specification	00	21/08/2026	Tender Issue
M01	Commissioning	00	21/08/2026	Tender Issue
M02	Planned Preventive Maintenance	00	21/08/2026	Tender Issue
M05	Existing Services	00	21/08/2026	Tender Issue
M11	Heating Emitters	00	21/08/2026	Tender Issue
M12	Heating Pipework	00	21/08/2026	Tender Issue
M20	Ventilation Plant	00	21/08/2026	Tender Issue
M21	Air Terminal Devices	00	21/08/2026	Tender Issue
M22	Ventilation Installations	00	21/08/2026	Tender Issue
M23	DX Air-Conditioning Plant	00	21/08/2026	Tender Issue
M31	Water Services Installations	00	21/08/2026	Tender Issue
M40	Soils and Waste Systems	00	21/08/2026	Tender Issue
M70	Building Management System	00	21/08/2026	Tender Issue
M70a	BMS Appendix _ MCC Schedule	00	21/08/2026	Tender Issue

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00.1 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.
- 00.1.4 The complete electrical installations shall comply with the Project Employer's Works Requirements documents.
- 00.1.5 The mechanical services scope of work for the Contractor includes for the supply, delivery, positioning, erection, connection, testing, commissioning and setting to work, of all plant and materials necessary to provide complete Mechanical Services Installation to the satisfaction of the Engineer and in accordance with the various drawings, schedules conditions and contractual documents and the requirements of this specification.

00.2 Materials

- 00.2.1 All products, materials and equipment shall comply with the project specification, as well as referenced standards and all applicable regulatory requirements.
- 00.2.2 Similar items of equipment and individual materials shall be selected from one manufacturer's range to standardise appearance, compatibility, maintenance and replacement.
- 00.2.3 Unless otherwise indicated, standard manufacturer's finishes and colours are to be provided.
- 00.2.4 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.
- 00.2.5 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.
- 00.2.6 In accordance with Article 23 of DIRECTIVE 2004/18/EC where technical specifications in these tender documents are defined by reference to a specific make or source, or a particular process, or to trademarks, patents, types or a specific origin or production it shall be deemed that the reference is followed by the words "or equivalent".

00.3 Construction Products Regulations

- 00.3.1 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.
- 00.3.2 All products where applicable must comply with relevant Harmonised European Standards (hENs)
- 00.3.3 From the 31st December 2020, manufacturers, distributors, importers, and authorised representatives must comply with their obligations and responsibilities under Regulation (EU) 305/2011 when placing a construction product on the EU market.
- 00.3.4 Both authorised representatives and importers must be established in the EU-27.
- 00.3.5 UK Notified Bodies will lose their status as EU Notified bodies the end of the transition period.
- 00.3.6 Manufacturers, distributors, importers and authorised representatives of construction products will need to take the necessary steps to ensure that they hold certificates under the responsibility of an EU27 Notified Body to demonstrate compliance for products placed on the EU market post-Brexit. In practice, this means either:
- arrange for a transfer of their files and the corresponding certificates from the UK 'notified body' (a 'notified body' registered in the UK) to an EU-27 'notified body', or
 - apply for a new certificate with an EU-27 'notified body'
- 00.3.7 Either step should be taken before the end of the transition period on 31st December 2020.
- 00.3.8 The UK Accreditation Service will cease to be a national accreditation body within the meaning and for the purposes of Regulation No 765/2008.
- 00.3.9 The Contractor must follow the guidance and changes outlined above. The Contractor must all make sure that the CE Marking / Declaration of Performance and relevant product related documentation is appropriate to demonstrate and ensure compliance with the Building Regulations.
- 00.3.10 All products where applicable must comply with relevant Harmonised European Standards (HENS)
- 00.3.11 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.

- 00.3.12 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.
- 00.3.13 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.
- 00.3.14 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.
- 00.3.15 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.
- 00.3.16 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.

00.4 Co-ordination and Liaison with other Trades

- 00.4.1 The Contractor shall be responsible for co-ordination of his works with other Contractors and sub-Contractors and determine and advise of necessary builder's work and attendances by the Main Contractor.
- 00.4.2 The Contractor shall note that Roscommon University Hospital development is considered to be part of a "live" environment which has adjoining and connected businesses, with other activities being undertaken at the same time as the proposed works. The Contractor shall note that all other and existing operations, water, gas services etc., will be required to be maintained live. The Contractor must survey all connections to adjoining and connected users, whose gas supply is from the same gas networks connection location. Any gas or water connections that are identified must be maintained and where necessary the Contractor must allow for temporary works to ensure no disruption to neighbouring operations.
- 00.4.3 The Contractor shall be expected to develop liaison strategies, installation details and methodologies in conjunction with the various specialists, suppliers and client direct service providers. The Engineer shall not be responsible for any co-ordination between contractors, specialists, or suppliers.
- 00.4.4 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.
- 00.4.5 The Contractor shall be responsible for the design and implementation of all temporary works associated with phasing, or to maintain operational areas live during the works. Contractors' proposals shall be detailed on method statements and where necessary supplemented with drawings for review by the Engineer.
- 00.4.6 The Contractor shall review all works requirements / project scope documentation with other sub-contractors and specialists prior to any installation. This shall include specialist supplier's information such as mechanical plant systems, Process Gases and installations, control systems, door equipment, lift installations and any other specialist elements being provided by other trades or to which the Contractors works are to be interfaced with.
- 00.4.7 The Contractor shall review all mechanical and electrical layouts with other Contractors prior to any installation. Similarly, the Contractor must ensure that manufacturers recommendations in terms of installation details are followed, and all such details must be established at an early stage during the co-ordination process. This must include positioning in respect of access for future maintenance, and replacement of consumable, or system critical components. Access for maintenance shall include all recommended safety clearance zones. The Contractor shall be responsible for complete and detailed co-ordination. In the event of installations being carried out where effective co-ordination and all installation requirements have not been adequately considered, the Contractor shall be responsible for undoing works, along with re-installation to satisfactory detail. All costs and time implications shall be the responsibility of the Contractor.

- 00.4.8 The Contractor will make available the appropriate personnel for attendance at site co-ordination meetings. Technical Site Meeting frequency with attendance by the Engineers shall be fortnightly during the services installation phases, with weekly co-ordination and planning meetings to be held by the Contractors and chaired by the Main Contractors services coordinator. The Engineer does not have any role in the coordination of Contractors.
- 00.4.9 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.
- 00.4.10 The Contractor shall review mechanical and electrical layouts with other Contractors prior to any installation.
- 00.4.11 The Contractor will make available the appropriate personnel for attendance at site co-ordination meetings. Technical Site Meeting frequency with attendance by the Engineers shall be fortnightly during the services installation phases, with weekly co-ordination and planning meetings to be held by the Contractors and chaired by the Main Contractors services coordinator. The Engineer does not have any role in the coordination of Contractors.
- 00.4.12 The Contractor shall note the Catering specialist designers and other client fit-out specialists shall provide fittings and equipment under separate contract. The Contractor shall include for all liaison with specialists and shall establish all requirements not later than the first fix installation stage.
- 00.4.13 The Contractor shall be responsible for all liaison with the specialist contractors, to verify all requirements, specifications and final positions for all equipment. The Contractor shall include for attendance at meetings and workshops where technical requirements are being discussed.
- 00.4.14 The Contractor shall “work with” and provide attendances to the specialists during their installation, commissioning and handover phases, providing completed and tested electrical installations in sufficient time for the specialists to complete their commissioning and set-up.
- 00.4.15 The Contractor shall establish and advise at an early stage, dates where materials and equipment being provided by the specialists will be required on site to enable erection and connection.
- 00.4.16 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.
- 00.4.17 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 etc.)
- 00.4.18 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.

- 00.4.19 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.
- 00.4.20 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 Contractors expense. (e.g. pipework crossing or in proximity to electrical distribution or Comms equipment etc.)
- 00.4.21 The Contractor will make available the appropriate personnel for attendance at site co-ordination meetings, technical meetings, and project progress meetings. Technical meetings shall be scheduled to occur fortnightly to be attended by the technical representatives of the contractor and their specialist sub-contractors. Project progress meetings shall be scheduled to occur fortnightly. In advance of each Progress meeting the contractor shall be expected to have issued a detailed progress report for review by all before the scheduled meeting.

00.5 Production of Information - Builders Works and Attendances

- 00.5.1 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.
- 00.5.2 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.
- 00.5.3 The Contractor shall provide detailed installation and working drawings to include sections and details, room data sheets with wall elevations. All drawings shall be produced in CAD and shall be issued to the design team in AutoCAD format for comment prior to commencement of installations.
- 00.5.4 The Contractors drawings shall include 1:20 and 1:50 sections, elevations and details clearly identifying the Contractors proposals and requirements to provide a full working installation in compliance with this specification, manufacturer's guidelines and industry good practice.

00.6 Production of Information – Interfacing and Connections to Existing Services

- 00.6.1 The Contractor shall note that a permit to work system will be operated by management and no works to existing services may be undertaken without approval.
- 00.6.2 Works involving tie-in, interfacing or connections to existing services such as, heating, water, ventilation, above ground drainage and gas networks, shall only be carried out having obtained agreement and approval to proceed.

- 00.6.3 In order to obtain approvals, the contractor must submit in good time detailed method statements and risk assessments, fully describing the tasks to be carried out, identifying any implications for the client in terms of temporary down time etc., Method statements shall be submitted at least 10 days before works are required to commence. The contractor shall note that connections to existing may be restricted to weekend work.
- 00.6.4 A schedule of Method Statements will be required and shall be developed by the Contractor at an early stage of the works.

00.7 Production of Information - Procurement Details

- 00.7.1 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.
- 00.7.2 The Contractor shall note that “alternative” proposals put forward by the Contractor shall not be accepted on the basis of delays to programme due to lead time of the specified products where it is deemed that the Contractor did not advance the technical submittal and procurement process in sufficient time. The Contractor shall be fully responsible for all programme implications and for any additional shipping costs for express freight delivery etc.
- 00.7.3 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.
 - Expected on site delivery dates
- 00.7.4 All technical submittals shall be issued in the following format.
- A full index of items, date & revision number of submittals shall be included on the submittal title page.
 - All manufacturers / Supplier’s 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.
- Technical Submittals shall be on a full system basis in order that the Engineer can consider all aspects of the Contractors proposals. Submittal of individual components will be rejected where it is considered that these may form part of a wider system.
- 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.

- 00.7.5 It is the contractor's responsibility to ensure that technical submittals are fully compliant, prior to submission. IN2 will review 2No. iterations of the same submittal. Should the contractor continue to issue non-compliant submittals, IN2 will escalate the matter with the project team and will not review any further submittals from the contractor until an improvement plan is agreed. The Contractor shall be aware that additional costs incurred by the Engineer associated with technical reviews shall be submitted on an hourly rate basis to the client, who may seek reimbursement from the Contractor.
- 00.7.6 The Engineer shall provide a response using a Status A, Status B, or Status C format, with Status A to reflect acceptance of the proposal, Status B to mean acceptance on the condition of comments being addressed and Status C to mean outright rejection.
- 00.7.7 Status B comments must be addressed, and evidence of satisfactory resolution must be submitted to the Engineer within 10 days, or the Status will automatically revert to Status C. The Contractor shall note that progression on the basis of Status B comments is completely at the Contractors own risk and any works undertaken or materials ordered may be rejected pending the responses provided by the Contractor to the Engineers comments. Any costs or programme implications as a result of rejected materials or works undertaken shall be the responsibility of the Contractor.
- 00.7.8 Status C response will be as a result of incomplete information, or aspects identified as being not as per specifications, or works requirement. Status C response will require a complete resubmission by the Contractor and once resubmitted will commence a new 10 working day review period.
- 00.7.9 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.
- 00.7.10 In addition to technical submittals, the Contractor shall provide "Benchmark Mock-ups", of main supports and primary installation elements, ductwork, fire smoke dampers etc., shall be provided by the contractor based on technical information submitted.
- 00.7.11 Samples shall be provided and erected within a designated "samples area" for design team comment and approval. All samples shall be operational and connected.

00.8 Production of Information – Detailed Installation Drawings

- 00.8.1 The Contractor shall survey and examine all existing installations indicating details where modifications to the existing systems may be required. The Contractor shall provide detailed “construction” drawings identifying “tie-in” locations, new wiring configurations and all necessary information to fully outline the Contractors works proposals.
- 00.8.2 The Contractor shall provide “as installed” and fully updated record layout drawings completed to reflect any modifications or changes made to the existing systems through the course of the project. As “as- built” are not available, the Contractor shall be expected to reflect all installations (new and existing) in a complete set of record information documents including drawings.
- 00.8.3 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 for all proposed mechanical and electrical systems. These drawings shall be fully co-ordinated and checked against electrical services along the proposed routes. All builder’s works’ implications such as forming of opes must be clearly highlighted and submitted for approval before the installation of any works proceeds. The Contractor shall allow a period of not less than 3 weeks for review of initial drawings. The Contractor shall ensure that drawings are submitted with sufficient time for review of drawings and any necessary modification and re-review so as not to impact on proposed installation dates. The Engineer shall not be responsible for any programme delays as a result of sufficient time not being allowed.
- 00.8.4 The Contractor shall be responsible for providing detailed working drawings. These drawings shall include details of maintenance zones requirements associated with mechanical and electrical plant. The Contractor shall be responsible for determining all necessary ducting and pipework routes, pipework drops, maintenance access requirements i.e. access hatch requirements to ductwork, waste pipework etc. and final connections etc.
- 00.8.5 The Contractor shall be responsible for providing detailed working drawings to show installations and maintenance details of the heat pump and associated buffer vessels, external façade louvres, Air Handling Unit, motorised dampers and fire smoke dampers.
- 00.8.6 The Contractor shall be responsible for detailing all primary mechanical services and producing specific installation details and drawings for all of the works within the contract and for connections to items of plant or equipment not supplied under the contract but forming part of the works.
- 00.8.7 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.
- 00.8.8 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 Contractors expense.

- 00.8.9 The Contractors drawings shall include 1:100 plan layouts and 1:50 sections, elevations and details clearly identifying the Contractors proposals and requirements to provide a full working installation in compliance with this specification, manufacturer's guidelines and industry good practice.

00.9 Production of Information – Requests for Information

- 00.9.1 The Contractor shall initiate a trackable Request for Information (RFI) process, with RFI's to be submitted to the Engineer only in situations where technical clarification is needed, or where additional technical guidance from the Engineer is required.
- 00.9.2 RFI's related to site matters, or queries between contractors shall not be directed to and will not be responded to by the Engineers. All such Contractor queries shall be discussed between the Contractors during site planning meetings.
- 00.9.3 RFI's shall be based on the Contractors own appropriate forward planning and where they have already reviewed all provided drawings, specifications and general works requirements documents. RFI's submitted where the Contractor has not reviewed the information will be rejected.
- 00.9.4 The Contractor shall note the minimum period for response to RFI's is 10 working days and this may be longer if the Engineer requires further clarification from the Contractor, or where a site visit is required to assess the query. The Engineers site visits will be scheduled as per fortnightly site meetings. The Contractor shall be responsible for all programme implications for RFI periods and for any knock-on implications, especially where it is deemed that the RFI's have been generated on the back of poor forward planning and coordination by the Contractor.
- 00.9.5 Contractors RFI's shall be assigned with an appropriate priority reflective of importance of the information required in the context of the project programme. Unreasonable RFI priorities where the importance is being overstated will be rejected by the Engineer until reasonable positions are stated.

00.10 Quality Control and Workmanship

- 00.10.1 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.
- 00.10.2 Evidence of quality control procedures being in place must be demonstrated in this regard. Details of the contractor's QA/QC procedures must be submitted to the Engineer and Client Representatives
- 00.10.3 Only persons suitably trained with the necessary qualifications and experience appropriate to the task shall carry out installation works.
- 00.10.4 The Contractor shall refer to BS 8000 "Workmanship on Construction Sites" and shall implement best practice in this regard.
- 00.10.5 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 trade's person is not exceeded on site. Evidence will be requested to demonstrate compliance in this regard.
- 00.10.6 The Contractor shall execute his works in accordance with industry standards and any relevant guidelines offered by codes of practice or applicable regulations.

- 00.10.7 The Contractor shall establish and implement manufacturers' installation instructions and procedures in full.
- 00.10.8 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.
- 00.10.9 Defective or sub-standard installations or workmanship shall be rectified at the expense of the Contractor.
- 00.10.10 Prior to commencement of installations the Contractor shall present to the Engineer detailed "benchmarking details", to include sketch proposals and reference photographs to clearly illustrate the Contractors proposed installation methods and providing details of the minimum standards of installation that are to be expected.
- 00.10.11 In addition, the Contractor shall be expected to construct "mocked up" sample installations fully reflective of the installation methods and proposals. These "mock-ups" once accepted shall be retained as "benchmark" samples on which the installations will be based. Mock-ups are required for elements such as;
- 00.10.12 Fire Collars, Fire / Smoke Dampers, Waste Rodding Eyes, MEP Supports, Exposed Services Installation, maintenance access etc.
- 00.10.13 In addition to benchmarking, working samples shall be provided for elements such as ventilation diffusers, radiators, heating manifold and underfloor heating loops, where samples are to be connected and erected in an environment reflective of the final application.

00.11 Building Control Regulations

- 00.11.1 The Contractor shall be responsible for ensuring full compliance with the Building Control Act 2007 and Building Control Regulations including the Building Control (Amendment) Regulations 2014.
- 00.11.2 The Contractor shall comply with the "Code of Practice for Inspecting and Certifying Buildings and Works", and shall co-operate with the Design Team and Assigned Certifier.
- 00.11.3 The Contractor shall be responsible as an "Ancillary Certifier", having design responsibility for particular aspects of the mechanical and electrical installations and as, "competent technical and trade persons that install products and/or test on completion", as such the Contractor shall participate fully and undertake all requirements as may be outlined by the Assigned Certifier.
- 00.11.4 The Contractor shall ensure that a competent person is assigned to oversee the Construction works and to ensure that all workmanship complies with the requirements of the Building Regulations.
- 00.11.5 The Contractor shall ensure that all materials which they select and for which they are responsible comply with the requirements of the Building Regulations.
- 00.11.6 The Contractor as "Ancillary Certifier" shall liaise with the Assigned Certifier in the development and implementation of the project Inspection Plan.
- 00.11.7 The Contractor shall provide Compliance Certificates and any other requested documents to the Assigned Certifier for the purposes of handover and certification, or as may be requested by the Building Control Authority.

- 00.11.8 The Contractor shall provide all Test and Compliance Certificates to the satisfaction of the Assigned Certifier and the Engineer. These certificates must be presented in sufficient time for review prior to issue of the Certificate Completion Stage.
- 00.11.9 Ancillary Certificates of Compliance are required from the following “Specialist” contractors
- 00.11.10 The design, installation, commissioning and certification of the air heat pump complete systems shall be coordinated and executed by the same accredited Certified heat pump specialist to ensure optimal performance and compliance with technical specifications.
- Heat Pump Specialist
 - Portable fire extinguishers.
 - Air Conditioning Specialist.
 - Building Management System (BMS)
- 00.11.11 These ancillary certificates must comply with the suite of certificates developed by RIAI, ACEI, Engineers Ireland and SCSi specifically:
- Ancillary Certificate Compliance: Design (Commencement / 7 Day Notice)
 - Ancillary Certificate Compliance: Design (Completion)
 - Ancillary Certificate Compliance on Completion
- 00.11.12 The Contractor shall be responsible for the Design, Selection and installation of the complete support & Bracketry systems (inc plinths & proprietary support systems), for all services included in the mechanical package, 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.
- 00.11.13 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.
- 00.11.14 The Contractor shall ensure that a competent person is assigned to oversee the Construction works and to ensure that all workmanship complies with the requirements of the Building Regulations
- 00.11.15 The Contractor shall ensure that all materials which they select and for which they are responsible comply with the requirements of the Building Regulations.
- 00.11.16 The Contractor as, “Ancillary Certifier”, shall liaise with the Assigned Certifier in the development and implementation of the project Inspection Plan.
- 00.11.17 The Contractor shall provide Compliance Certificates and any other requested documents to the Assigned Certifier for the purposes of handover and certification, or as may be requested by the Building Control Authority.

- 00.11.18 The Contractor shall provide all Test and Compliance Certificates to the satisfaction of the Assigned Certifier and the Engineer. These certificates must be presented in sufficient time for review prior to issue of the Certificate Completion Stage.
- 00.11.19 Consideration must be given to the requirement for commissioning and certification together with the preparation and submission of "Ancillary Certification" in the project programme. The Contractor must schedule and detail all requirements in his works programme for incorporation in the Main Contractors master construction programme. The Contractor shall be responsible for ensuring that Certification is issued in adequate time to allow the submission of the "Certificate of Compliance on Completion", lack of awareness, or programme constraints will not be acceptable for failure to allow sufficient time for completion of "Ancillary Certifiers" requirements, where the Contractor has not adequately made provision, or has not informed the Main Contractor of the minimum necessary task durations.
- 00.11.20 The Contractor shall note that failure to undertake any aspects relating to Building Control will result in the non-submittal of the "Certificate of Compliance on Completion". The Contractor shall note that the Building cannot be opened, used or occupied until a valid Certificate of Compliance on Completion is accepted by the Building Control Authority.
- 00.11.21 The Contractor shall note that the Engineer will not provide their "Ancillary Certification" if there is any outstanding works, any outstanding defects, incomplete documentation, outstanding Contractors "Ancillary Certificates", or any other relevant documents on which the Engineer would rely. On this basis the Engineer will not be responsible for delays in submitting the "Certificate of Compliance on Completion", where information is outstanding.

00.12 Firestopping

- 00.12.1 All mechanical services penetrating fire walls shall be fire stopped. The Contractor shall refer to Architects drawings for details of fire compartment walls and associated fire rating.
- 00.12.2 The Contractor shall include for the provision, installation, labelling and certification of proprietary fire stopping materials, fire/smoke dampers etc., within Mechanical distribution systems.
- 00.12.3 The Main Contractor shall be responsible for the provision of Fire Stopping to services open's, risers, fire collars etc formed as part of these work. However, the Mechanical Contractor shall also ensure that all Fire Stopping deficiencies identified during the course of the works are brought to the attention of the Main Contractor. Once Fire Stopping has been installed the Contractor shall not disturb or modify the firestopping to facilitate any further installation. Any modifications to fire stopping shall be correctly repaired or reinstated by the Fire Stopping specialists.
- 00.12.4 The Contractor shall bring to the attention of the Main Contractor any additional fire stopping requirements which may have been observed during the installation works, or where the Contractor has observed damage to installed fire stopping all such locations shall be advised to the Main Contractor for remedial action.
- 00.12.5 Refer to the IN2 Engineering Builder Works attendance specification for the contractor's fireproofing specialist requirements.

00.13 Testing & Inspections

- 00.13.1 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.
- 00.13.2 Quality inspections are to be carried out by Contractors supervisory personnel to ensure that all installations are being undertaken in accordance with agreed benchmarks, industry best practices, manufacturers recommendations and requirements of the specifications. High levels of workmanship are minimum expectations. The Contractor shall develop installation workmanship check sheets and these shall be presented to the Engineer during site visits.
- 00.13.3 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.
- 00.13.4 The Contractor shall note the requirements for Commissioning and Handover and shall develop the Testing and Commissioning Plan to demonstrate the commissioning of electrical systems, particularly mains distribution, fire detection and alarm systems, emergency lighting systems and any other electrical systems that are required to be complete before BCAR completion certificates are required to be submitted to the Building Control authority. The Contractor shall include all allowances for phased systems commissioning.
- 00.13.5 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.
- 00.13.6 The Contractor shall prepare a written schedule giving a minimum of a 10-working day notice period of proposed test dates for witnessing by the Engineer. Not less than 24 hrs prior to scheduled witness testing, the Contractor must provide written confirmation to the Engineer and ER that the Contractor has completed all their own testing and verifications and are satisfied that all systems are fully commissioned and are fully ready to offer to the Engineer. The Engineer will NOT attend scheduled witness testing unless the written confirmation is received in advance. Rescheduling will need to be agreed with the Engineer, and this may require a further 10 day notice period pending Engineer schedules and availability.
- 00.13.7 Should the Engineer attend for witness testing and determine that the systems are not commissioned, or suitable for witness testing, the Engineer will advise the ER and site management and may cancel witness testing until the Contractor has completed their works.
- 00.13.8 Following acceptance by the Engineer, the Contractor shall include for final demonstration to the Client stakeholders and their representatives. The Contractor shall allow for attendances of specialists and technical suppliers during witness testing by the Engineer and during demonstrations to the Client.

- 00.13.9 In developing their commissioning programme, the Contractor shall include all commissioning tasks and activities and shall include appropriate periods for witness testing and client demonstrations. Witness testing schedules shall be co-ordinated by the Contractor to maximise time efficiency allowing for a maximum of two days attendances by the Engineer. The Contractor shall note that the Engineer shall only notify the client of pending Contractor demonstrations after the Engineer is satisfied with witness testing and has reviewed all commissioning results. The Contractor shall allow for notice periods in their programme.
- 00.13.10 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.
- 00.13.11 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.
- 00.13.12 The Contractor shall note that final acceptance and submission of BCAR certification by the Engineers will follow client demonstrations and initial familiarisation training.
- 00.13.13 The Contractor shall be fully responsible for adherence to completion programmes, BCAR submissions and notice periods, and shall be solely responsible for any implications due to failed commissioning that would delay Engineer witness testing and client demonstrations.
- 00.13.14 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. The Commissioning Programme shall be developed to indicate separate commissioning and handover activities.

00.14 Site Facilities

- 01.1.1 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
- 01.1.2 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.
- 01.1.3 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.

00.15 Site Supervision

- 00.15.1 The Contractor shall include for the provision of a full time, on site, suitably experienced Foreman for each shift operated, who's 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. The Foreman shall be fully familiar with Building Regulation Technical Guidance Documents, in respect of installation details, dimensions for compliance etc. and shall ensure that all trades operatives under their supervision fully comply with Building Regulation requirements when carrying out installation works. The Contractor shall be fully responsible for all costs and programme implications that may be associated with remedial works that may be necessary where non-compliance has been identified by the Building Control Authority, Specialist Installers, or by the Engineer.
- 00.15.2 Chargehands with responsibility for separately identifiable elements of the installation shall also be provided as required.
- 00.15.3 The Contractor shall include for the provision of adequate supervision for the entire duration of the works. The Contractors supervisory staff shall be on site throughout the whole time of the works and at no stage shall Contractors operatives be un-supervised.
- 00.15.4 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 1 day per week with additional attendance coinciding with site meetings and critical stages of the project.
- 00.15.5 As works progress the requirement may increase to full time attendance of the Contracts Manager and allowances shall be made for same.

00.16 Operation and Maintenance Manuals

- 00.16.1 Preparation of operating and maintenance manuals shall be based on the following documents:-
- 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
 - BSRIA BG1/2007 Handover, O and M manuals and project feedback
 - BSRIA BMS Maintenance Guide BG 4/2003 Plus a model maintenance specification
 - BSRIA BG 2/2004 Computer-based operating and maintenance manuals - Options and procurement guidance
 - BSRIA BG 26/2011 Building Manuals and Building User Guides - Guidance and worked examples.
- 00.16.2 At an early stage of the contract, the Contractor shall submit a preliminary draft set of Operation and Maintenance Manuals, to the Engineer for comment.

- 00.16.3 10 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.
- 00.16.4 The Contractor shall obtain preferred O&M structures and formats at an early stage, which shall form the basis of the Contractors O&M. The draft formats shall be presented to and agreed with the PSDP. Note an electronic and hard copy format O&M / Safety File is required. The electronic Safety File shall be constructed by specialists.
- 00.16.5 The Contractor shall obtain preferred O&M structures and formats at an early stage, which shall form the basis of the Contractors O&M. The draft formats shall be presented to and agreed with the PSDP. Note an electronic and hard copy format O&M / Safety File is required. The electronic Safety File shall be constructed by specialists.
- 00.16.6 The O&M shall be developed throughout the project and shall be submitted in final draft four weeks before the date for Substantial Completion of the project, at which time it will be agreed that only information to be added to the files will relate to final commissioning and certification. The Contractor shall note that provision of O&M information is a requirement under BCAR, and delayed provision of the O&M will delay BCAR
- 00.16.7 After final approval from the Engineer and before making application for final payments, the Contractor shall present the following:
- 2 No. Paper Copy (Colour Print, bound in A4 Size folders, Drawings folded to suit (sizes to be agreed with Employers' Representative)
 - 2 No. USB (".doc" and ".pdf" formats generally) submitted electronically in original format and as well as pdf format.
- 00.16.8 The Operation and Maintenance Manual shall contain the following as a minimum;
- A detailed asset management register to the Employer's template outlining element, cost, warranty period, maintenance schedules and requirements, expected meantime between failures, maintenance company, contact details, etc. and all other information pertinent to the installation;
 - A list of the 'As-Built' Drawings;
 - A description of the general works and of each service installation and fittings;
 - A description of the method of operation of each service/installation and fittings, including the independent method of operation of each item of plant and equipment;
 - Detailed procedure for starting up each of the services/installations whether individually or as a whole;
 - Detailed procedure for shutting down each of the services/installations whether individually or as a whole;
 - A description of the maintenance methods and routine procedures and requirements for each service/installation and fitting, including each item of plant, equipment and fitting;
 - A list of manufacturers, suppliers, installers, trade names, model and/or catalogue numbers, for all items of plant, equipment and fittings including

complete with ordering references and all manufacturers' names and works addresses;

- Wiring diagrams and Schematics for all items of plant and equipment;
- Copies of manufacturer's literature, including operating instructions and maintenance procedures for all items of plant, equipment and fittings;
- Copies of manufacturer's detailed drawings of all items of plant, equipment and fittings;
- Health & Safety procedures and guidelines & Project Safety File;
- Fault finding procedure;
- Emergency plant failure procedure;
- A list of spares to be stocked by the Employer;
- Original copies of all test certificates, data and results arising out of testing and commissioning the Works;
- Manufactures guarantees or warranties

00.16.9 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 USB format.

00.16.10 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.

00.17 Training and Familiarisation

00.17.1 The Contractor shall provide full training and familiarisation to the Client or persons nominated by the Client. The training and familiarisation shall be provided on all aspects of the installed systems and the use of the O&M Manuals. The Contractor shall ensure the attendance of all specialist suppliers who shall describe their systems, highlighting specific relevant items of note to include, maintenance requirements and clients responsibilities.

00.17.2 The training and familiarisation shall be expected to be provided on two occasions, at times to be scheduled and agreed with the client. At least one of the occasions must be completed before Handover of the building with a further session to be held at the request of the client and within six weeks of occupation.

00.17.3 The Contractor shall note that the client may refuse to accept handover of the building until such time as adequate training and familiarisation has been provided. It should also be noted that final BCAR acceptance and submission of completion certification cannot proceed until training in the use of the systems has been provided.

00.18 Handover

- 00.18.1 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.
- 00.18.2 As part of the familiarisation training, the Contractor shall be expected to demonstrate a working understanding of the installed systems to a level that can be conveyed to the client to enable the client's technical staff to operate the systems and installations, to their full potential with confidence.
- 00.18.3 The Contractor shall note the following minimum requirements in order to achieve handover;
- Completed O&M's
 - Completed Demonstrations to the Engineer
 - Completed Client / Operator Training
 - Completed Client Demonstrations
 - Completed "snags"
 - Completed Certification
 - Provision of spare materials and equipment
- 00.18.4 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.
- 00.18.5 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.

00.19 Maintenance Period

- 00.19.1 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.
- 00.19.2 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.
- 00.19.3 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.
- 00.19.4 All visits shall be scheduled to occur at times suitable to the client.

- 00.19.5 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.
- 00.19.6 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, cleaning dirt/ air separator filters etc.
 - Maintenance of Ventilation Systems including replacement of both panel and bag filters to Heat Recovery Units, checking/ replacing fan motor as required including local and fume extract fans, checking fan operation, checking dampers are open etc.
 - Maintenance of Water and Wastes systems including re-adjustment of pressures as required, flushing and cleaning of the entire system including all sanitaryware and TMV strainers, replacing of filters etc.
 - Maintenance of Specialist motorised dampers.
 - Maintenance of Fire Fighting Installations including overseeing checks to extinguishers by the specialist contractor.
 - 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.
- 00.19.7 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.
- 00.19.8 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.

- 00.19.9 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.
- 00.19.10 remedial action but was not possible to address within the context of the PPM visit.
- 00.19.11 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.

00.20 Seasonal Commissioning and Handover

- 00.20.1 The specialist commissioning contractor shall carry out seasonal commissioning to verify system performance under varying load conditions. This will involve return visits to site during the first 12 months of operation to check and fine-tune system controls and performance during both heating and cooling seasons. A comprehensive commissioning report, including all test records, calibration certificates, and performance data, shall be submitted as part of the building logbook for final handover.

00.21 Defects Liability

- 00.21.1 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.
- 00.21.2 The term defect in shall be interpreted as:
- 00.21.3 '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'.
- 00.21.4 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.

00.22 Manufacturers Warranties

- 00.22.1 The commencement of Manufacturers warranties shall be from the date of Handover to the client and not from date of Contractors receipt to site. Any extension to manufacturers warranties that may be required to comply with the above must be included by the Contractor.
- 00.22.2 All warranty information shall be included in the Handover file.

00.23 Controls Devices

- 00.23.1 The Mechanical Contractor shall be responsible for installing all control devices to both pipework and ductwork systems.
- 00.23.2 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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01.1 Outline Description & Management

- 01.1.1 The Mechanical Contractor holds full responsibility for the comprehensive testing, flushing, cleaning, chemical dosing, and commissioning of all Mechanical Services systems detailed within the contract documents. This includes providing all necessary calibrated instrumentation and competent, qualified personnel to execute the works.
- 01.1.2 The Contractor shall develop and submit detailed commissioning method statements and a comprehensive Commissioning Plan for review and approval by the Engineer at least four weeks prior to commencing any testing activities. The Contractor shall retain specialist sub-contractors for specific tasks, including but not limited to, the pre-commission cleaning of pipework systems, and shall ensure that manufacturer-certified representatives commission specific equipment such as pressurisation units and heat pump systems where required.
- 01.1.3 The Contractor shall retain specialist sub-contractors for:
- Water Treatment & Cleaning, Pre-commission cleaning and chemical treatment of pipework in strict accordance with BSRIA BG 29/2021.
 - Comprehensive testing and certification of Fire and Smoke Dampers by a specialist to ensure compliance with BS 9999 and technical standards.
 - Independent Validation, Third-party validation of all Air and Water balancing results to ensure design flow rates are achieved and documented.
 - Building Management Systems (BMS), Specialist integration, software logic verification, and point-to-point testing of the automatic control systems.
 - Acoustic & Vibration, Verification of noise levels and vibration isolation efficiency for plant equipment in sensitive areas (if applicable).

01.2 Standards

01.2.1 All testing and commissioning activities shall comply with the latest editions of the following standards:

- BSRIA BG 29/2021: Pre-commission Cleaning of Pipework Systems (Amended 6th Edition).
- BSRIA BG 49/2024: Commissioning Air Systems.
- BSRIA BG 2/2010: Commissioning Water Systems.
- BSRIA BG 88/2025: Commissioning Responsibilities Framework.
- CIBSE Commissioning Code A: 2024: Air Distribution Systems
- CIBSE Commissioning Code W: 2025: Water Distribution Systems.
- CIBSE Commissioning Code C: 2001: Automatic Controls.
- CIBSE Commissioning Code R: 2002: Refrigerating Systems.
- CIBSE Code R, BS EN 378 - Refrigeration/Heat Pumps
- BS EN 378:2016+A1:2020 - Refrigerating systems and heat pumps. Safety and environmental requirements Basic requirements, definitions, classification and selection criteria

01.3 Pre-Commissioning Cleaning of Pipework Systems

- 01.3.1 The pre-commissioning cleaning shall be executed in strict accordance with BSRIA BG 29/2021. The following witnessing and testing procedure must be completed and documented by the specialist sub-contractor.
- Prior to Flushing: Samples of the fill-water shall be tested for total viable counts (TVC), Pseudomonas, and sulphate-reducing bacteria. If any system has contained water for more than two weeks, it shall also be sampled and tested.
 - During Flushing: The Engineer shall witness flushing velocities and the cleanliness of strainers and dirt pockets.
 - Post-Flush / Pre-Chemical Clean: A visual inspection and a soluble iron test shall be conducted. The soluble iron concentration must not exceed 5 mg/l.
 - Post-Chemical Clean: A visual inspection of internal pipework surfaces shall be carried out by removing a designated, easily demountable pipe section.
 - Final Dosing & Acceptance: After the final fill and addition of inhibitors, random water samples shall be taken. The results from all samples must lie within the following limits:
 - Suspended Solids: Less than 30 mg/l.
 - Soluble Iron: Less than 5 mg/l.
 - Total Iron: Less than 15 mg/l.
 - Chloride & Sulphate: No higher than the incoming mains water.
 - Chemical Inhibitor Levels, Alkalinity, pH, TDS: As recommended by the water treatment specialist.
 - One Week Post-Clean: The system shall be re-tested for bacteria levels to confirm the success of the clean, with results interpreted according to BSRIA guidelines.
- 01.3.2 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.
- 01.3.3 The following system of testing and witnessing must be completed and documented by the specialist sub-contractor.
- 01.3.4 One week before pressure testing:
- Take samples from the flushing fill-water connection to the system. Test the samples for total viable counts (TVC), Pseudomonas, and sulphate reducing bacteria. Interpret the results (taking advice from a chemical cleaning specialist) in accordance with Table 2.
- 01.3.5 One week before commencing of flushing and chemical cleaning:
- If the system contains water and has done so for a period of more than two weeks, then this water should be sampled and tested for TVC, Pseudomonas

and sulphate-reducing bacteria levels. The results should again be interpreted (taking advice from a chemical cleaning specialist) in accordance with Table 2.

01.3.6 During both flushing stages:

- The Consultant Engineer and Mechanical Contractor shall witness flushing velocities and the cleanliness of strainers and dirt pockets in all parts of the system. A sample of any material extracted should be retained for future reference.

01.3.7 On immediate completion of the pre-chemical clean dynamic flush, the Mechanical Contractor shall carry out:

- A visual inspection of the water to confirm cleanliness
- A soluble iron test. The soluble iron concentration of the system water must not exceed 5 mg/l. Results of these tests and associated samples must be supplied to the Consultant Engineer.

01.3.8 On completion of the chemical clean carry out:

- A visual inspection of the pipework surfaces (by removal of a specially prepared, easily demountable section of pipe) & Submit a water sample to the Consultant Engineer.

01.3.9 On completion of the chemical clean, and after the final fill and addition of corrosion inhibitors and biocides the Mechanical Contractor shall carry out:

- Routine checks on strainers to ensure that particles collected are minimal
- Random sampling of the system water for chemical testing. Water should be taken from representative system extremities and low points. At an agreed position in the system, samples should be taken for record purposes, one to be kept by the client, and one to be kept by the cleaning specialist. The results from all samples must lie within the following limits:

Total alkalinity (mg/l CaCO ₃):	As recommended by the chemical cleaning/water treatment specialist
Chloride (mg/l Cl):	No higher than in incoming mains water (or as specified).
Sulphate (mg/l SO ₄):	Equal to that of incoming mains water.
Total dissolved solids (conductivity- microSiemens):	As recommended by the chemical cleaning/water treatment specialist.
Suspended solids (mg/l):	Less than 30 mg/l. (NB: This value allows for the fact that the addition of corrosion inhibitor will cause an increase in the amount of suspended solids in the system.)
pH:	Depending on water treatment method.
Soluble iron (mg/l Fe):	Less than 5 mg/l.
Total iron (mg/l Fe):	Less than 15 mg/l.

Chemical inhibitor levels:	As recommended by the chemical cleaning/water treatment specialist.
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01.3.10 One week after completion of the system clean and final dosing, the Mechanical Contractor shall:

- Test for bacteria levels and interpret the results in accordance with Table 2. Water samples should be taken from representative system extremities and low points. (NB: For the samples to be indicative of the success of the clean, the system water must be routinely circulated during the preceding week, and system integrity must be maintained (i.e. there must be no loss of water from the system). The introduction of fresh water during this period could re-introduce contamination.

01.3.11 Table 2: Interpretation of results from bacterial analysis in closed circuit systems.

Result	Interpretation
TVC at 22°C and 37°C ≤ 10 000 cfu/ml* AND Pseudomonas <10 cfu/ml AND Sulphate-reducing bacteria absent	The water quality is acceptable. Continued routine monitoring is required.
TVC at 22°C and 37°C ≤10 000 cfu/ml AND Pseudomonas between 10 – 50 cfu/ml AND Sulphate-reducing bacteria absent	The water quality is acceptable. Increased monitoring may be required to establish if there is an upward trend in bacteria levels. Biocide dosing may also be advisable, depending on the timing of the most recent dose. The chemical cleaning specialist should advise.
TVC at 22°C and 37°C >10 000 cfu/ml OR Pseudomonas >50 cfu/ml OR Sulphate-reducing bacteria present	Action may be necessary. The chemical cleaning specialist should advise.
*colony forming units per millilitre Conditions: Sample volume must be at least 100 ml. Samples must be stored at a temperature between 6-8°C and must be tested within 24 hours of being removed from the system. Tests should be performed by a UKAS accredited laboratory. Test results must be interpreted making allowance for the accuracy of test procedures. Any variation in results from samples taken at different points around the system should be investigated and, if necessary, further samples taken.	

01.4 Testing & Commissioning

- 01.4.1 The mechanical services scope of work for the Contractor includes for the supply, delivery, positioning, erection, connection, testing, commissioning and setting to work, of all plant and materials necessary to provide complete Mechanical Services Installation to the satisfaction of the Engineer and in accordance with the various drawings, schedules conditions and contractual documents and the requirements of this specification.
- 01.4.2 Consideration must be given to the requirement for commissioning and certification together with the preparation and submission of "Ancillary Certification" in the project programme. The Contractor must schedule and detail all requirements in his works programme for incorporation in the Main Contractors master construction programme. The Contractor shall be responsible for ensuring that Certification is issued in adequate time to allow the submission of the "Certificate of Compliance on Completion", lack of awareness, or programme constraints will not be acceptable for failure to allow sufficient time for completion of "Ancillary Certifiers" requirements, where the Contractor has not adequately made provision, or has not informed the Main Contractor of the minimum necessary task durations.
- 01.4.3 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.
- 01.4.4 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.
- 01.4.5 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.
- 01.4.6 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.
- 01.4.7 Where required by the Specification the Contractor will be obliged to engage third party testing and commissioning specialists.
- 01.4.8 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.
- 01.4.9 Commissioning Requirements – Pre-commissioning
- 01.4.10 The first step in the commissioning process, shall be the pre-commissioning and system prep/set-up to work of all the systems. This phase of work includes the works required to advance each system installation from static/practical completion to the commissioning phase including systematic verification of each completed system by the Commissioning Specialist to establish its suitability for commissioning.

- 01.4.11 The mechanical contractor shall carry out all Pre-commissioning checks as requested by the commissioning specialist to ensure all mechanical services system components are fit for purpose, correctly installed and ready for commissioning.
- 01.4.12 Each system, when it is installed shall be in accordance with the IN2 Engineering Design Partnership specification & final layout drawings. All systems shall be free of installation defects and be clean and safe to operate.
- 01.4.13 As part of the technical submission process, the mechanical contractor shall submit a separate technical submission relating to the front-end graphics. The mechanical contractor shall also submit a technical submission relating to the strategy of operations for all M&E systems. Client sign off is required for both these items prior to the commencement of the commissioning stage.
- 01.4.14 Cleaning of mechanical services installations:
- 01.4.15 All systems shall have been cleared of any obstruction and cleaned before the commissioning process can commence. There should be suitable access to all systems.
- 01.4.16 All water services systems shall be flushed and cleaned as part of the recommissioning process in accordance with BRSIA AG 1/2001 & Section M01 Pre-Commission Cleaning of Pipework Systems of the IN2 specification.
- 01.4.17 All air systems shall be completely clear of all debris using the installed fans or by other agreed alternative means.
- 01.4.18 Pre-commissioning Checks:
- 01.4.19 Air Systems (non-exhaustive checklist):
- The mechanical contractor shall ensure all air systems are cleaned and blown through to remove any debris.
 - The mechanical contractor shall check that all volume control dampers (VCD's) are installed correctly, tested for correct operation and positioned in the fully open position.
 - The mechanical contractor shall check that all Fire and Smoke Dampers (FSD's) are installed correctly, tested for correct operation and then reset.
 - The mechanical contractor shall ensure there is a provision of test holes. Test holes shall be drilled and sealed with removable plugs.
 - The mechanical contractor shall ensure regulation of fans to provide the appropriate flow rate.
 - The mechanical contractor shall check that all dampers (VCD's & FSD's) are secured into position and access doors marked with the following:
 - Date installation and operation checked.
 - Name of checker and checking organisation.
 - System Reference, direction of airflow and the unique damper reference code.
 - The contractor shall be responsible for ensuring the following list of pre-commissioning test sheets/records is available prior to the commencement of the commissioning stage:
 - Fire Smoke Damper installation certification (including all control and power cabling to and from each FSD and the FSD panel)

- Fire alarm link between FSD Panel & fire alarm panel (Verification by electrical contractor)
- Air Handling Units and Heat Recovery Unit assemblies
- Electrical current checks to all ventilation plant (extract fans, AHU's, smoke extract fans, run-around coils, supply fans, etc.) (Verification by electrical contractor)
- Volume Control Dampers are to be open prior to commissioning
- Air terminals / grilles to be checked that they are complete
- All ductwork to be cleaned
- All Fire rated ductwork shall be certified by the contractor and the manufacturer.

Equipment / System	No. of Certs	Date of Test	Test carried out by	Test witnessed by

01.4.21 Ductwork Cleanliness and Verification

01.4.22 The Contractor shall be responsible for the cleaning of all ventilation ductwork systems and for providing documented proof of cleanliness prior to the commencement of air balancing and commissioning. All procedures and outcomes shall comply with BS EN 15780 and the principles of the BESA guide TR/19.

01.4.23 Cleanliness Quality Class: All ventilation ductwork systems shall meet the criteria for Medium Quality Class as defined in BS EN 15780. This classification is applicable to the building's mix of offices, assembly areas, and general working spaces. The Contractor is reminded that all open ends of ductwork must be sealed with durable caps during construction to prevent the ingress of construction debris and minimise the cleaning required.

01.4.24 Verification Method and Acceptance Criteria: The cleanliness of the ductwork shall be verified using the European Vacuum Test (EVT). Dust accumulation levels at the time of handover for final commissioning must not exceed the prescribed limits. Any system failing to meet these criteria is unacceptable and will not be passed for commissioning.

01.4.25 The acceptable dust accumulation levels for the Medium Quality Class are:

- Supply & Recirculation Air Ductwork: < 0.6 g/m²
- Extract Air Ductwork: < 1.8 g/m²

01.4.26 Testing Procedure and Reporting: The Contractor shall engage a specialist to perform the European Vacuum Test (EVT) on representative sections of the ductwork system. This testing shall be carried out after the ductwork is installed but prior to the installation of terminal devices (grilles/diffusers) and the application of external thermal insulation.

01.4.27 The testing must be witnessed by the Engineer, and a formal test report shall be submitted for approval. The report must include:

- Date and time of the test.
- Location and identification of each ductwork section sampled.
- The measured dust accumulation level (in g/m²) for each sample.
- Photographic evidence of the testing procedure.
- Calibration certificates for the test equipment.

01.4.28 Any section of ductwork that fails to meet the acceptance criteria shall be re-cleaned and re-tested at the Contractor's expense until a satisfactory result is achieved. Final system commissioning shall not commence until this verification report is approved by the Engineer.

01.4.29 Water Services Installations (non-exhaustive checklist):

- The mechanical contractor shall ensure the water treatment dosing is completed before water balancing commences.
- The mechanical contractor shall ensure all valves shall be checked for correct installation, tested for correct operation and, except for normally closed valves, be set in the fully open position.
- The mechanical contractor shall ensure the correct pressure drops of all strainers (DN 100 and over). Pressure drops shall be measured at design flow

rate when clean. The results shall be kept as part of the commissioning records and identified on a permanent label attached to the strainer.

- The mechanical contractor shall flow measuring devices are in place and in the correct location.
- The mechanical contractor shall ensure all pipework systems have been cleaned and flushed to remove any debris, appropriate debris collectors and flushing facilities have been incorporated into the water services systems.
- The Mechanical contractor is responsible for ensuring the following pre-commissioning test sheet/records are available prior to the commencement of the commissioning stage:
 - LPHW Pipework Test Certs
 - S&W Pipework Test Certs
 - Refrigeration Test Certs
 - Pipework Flushing Certs
 - Pipework Sterilisation Certs
 - Pipework Chemical Dosing Certs
- Where appropriate completion of proportional balancing to obtain the branch flow rates in the correct ratio.

Equipment / System	No. of Certs	Date of Test	Test carried out by	Test witnessed by

01.4.30 Packaged Equipment (Heat Pump, Buffer Vessels, Refrigeration / AC systems, water treatment, LPG Systems etc.) (non-exhaustive checklist):

- The mechanical contractor shall ensure all heat pump & Refrigeration plant and controls are fully commissioned and functional, ready for integration with other plant / systems.
- The mechanical contractor shall ensure all controls / BMS inputs and outputs are operational and properly commissioned.
- The mechanical contractor shall ensure support services such as power and water supplies are provided where required.
- The Mechanical contractor is responsible for ensuring the following pre-commissioning certificates are available prior to the commencement of the commissioning stage:
 - Heat Pump System installation cert
 - Refrigeration certs (AC system)
 - Fire Smoke Dampers installation certs
 - Mechanical Ventilation Heat Recovery installation certs
 - Water Treatment certs

Equipment / System	No. of Certs	Date of Test	Test carried out by	Test witnessed by

01.4.31 Controls / BMS (non-exhaustive checklist):

- The BMS specialist is responsible for ensuring the BMS controls system is pre-commissioned to allow the building services plant to operate under manual running conditions.
- The BMS specialist is responsible for keeping record of all settings, set points and offsets etc. This should be maintained throughout the precommissioning period.
- The BMS specialist is responsible for ensuring the final BMS configurations or physical adjustments to the control system field devices is permanently marked so that any movement from the commissioned setting is immediately apparent.
- The BMS specialist is responsible for ensuring all packaged plant interfaced with the control system is fully tested and commissioned by the manufacturer or installer.
- The electrical contractor is responsible for checking that volt – free and control terminals are separated from the mains voltage.
- The BMS specialist is responsible for ensuring the following pre-commissioning certificates are available prior to the commencement of the commissioning stage:
- Confirmation from electrical contractor that all wiring and terminations is complete
- Physical point to point check (confirmation required from electrical contractor)
- Electronic point to point check (confirmation required from electrical contractor)
- Tagging of all plant and equipment to be controlled / displayed on the BMS front end
- Programming of front-end graphics
- MCC panel check
- MCC panel circuit breaker checks

Equipment / System	No. of Certs	Date of Test	Test carried out by	Test witnessed by

01.4.32 Electrical Wiring:

01.4.33 The electrical contractor shall ensure control panels shall be checked for completion, compliance with the wiring diagrams, and correct references are applied.

01.4.34 The electrical contractor shall ensure terminations to all control items and interlocked equipment are complete and checked.

01.4.35 The electrical contractor shall ensure all safety and emergency provisions are complete and checked. All safety and emergency provisions shall be in working order.

01.4.36 The electrical contractor shall ensure there are no faults in the system.

01.4.37 System Tolerances:

01.4.38 The mechanical contractor shall ensure that the water services installations are regulated to tolerances appropriate for the system type as described in CIBSE Commissioning Code A. Unless otherwise stated, air system tolerances shall be as per CIBSE guide A recommendations.

01.4.39 The mechanical contractor shall ensure all air systems have been balanced to minimise noise generation.

01.4.40 The mechanical contractor shall ensure all water systems are regulated to tolerances appropriate for the system type as described in CIBSE Commissioning Code W. Unless otherwise stated, water system tolerances shall be based on a 'medium' performance effect.

01.4.41 Final Settings Configuration:

01.4.42 The mechanical contractor shall ensure no regulating valve or commissioning is adjusted in excess of the manufacturer's recommendations.

01.4.43 The mechanical contractor shall ensure all water regulating devices shall be locked in their final positions in accordance with the manufacturer's approved method.

01.4.44 The mechanical contractor shall ensure final positions of water regulating devices or commissioning sets are recorded on the particular system commissioning record sheet.

01.4.45 The mechanical contractor shall ensure all volume control dampers are locked in the final position and permanently marked.

01.4.46 Detailed guidance is available in BSRIA Commissioning Documentation and in CIBSE Commissioning Codes for the full requirements of the pre-commissioning process. The contractor can also refer to the IN2 Engineering Design Partnership specification and layouts for more information. All these requirements should be completed and documented before proper commissioning of the systems commences.

01.4.47 Commissioning Requirements – Commissioning

01.4.48 The full commissioning of the systems within the Printing House Square Project should be carried out in accordance with the IN2 Engineering Design Partnership specification.

- 01.4.49 The contractor is responsible for developing specific method statements for the commissioning and detailed setting to work of all mechanical services systems, to illustrate the approach that is intended and to programme in detail all mechanical services works and dates on which witnessing by the Consulting Engineer could potentially take place (i.e. minimum notice period of 10 days).
- 01.4.50 All air and water services installations shall be pre-commissioned and commissioned in full accordance with the following BSRIA & CIBSE documents:
- BSRIA BG 29/2021 - Pre-Commission Cleaning of Pipework Systems.
 - CIBSE Commissioning Code W: 2010 and BSRIA BG 2/2010.
 - BSRIA BG 2/2010 - Commissioning Water Systems
 - BSRIA BG 49/2015 - Commissioning Air Systems.
 - CIBSE Commissioning Code C: 2001 and supported by BSRIA BG 1/2009 - Commissioning Management.
 - CIBSE Commissioning Code A: 2016 - Air Distribution Systems.
 - CIBSE Commissioning Code B: 2002 - Boilers.
 - CIBSE Commissioning Code C: 2001 - Automatic Controls.
 - CIBSE Commissioning Code R: 2002 - Refrigerating Systems.
 - CIBSE Commissioning Code W: 2010 - Water Distribution Systems.
- 01.4.51 List of the commissioning certificates that are being included in the operation and maintenance file is to be compiled by the commissioning agent(s).
- 01.4.52 The Mechanical contractor shall be responsible for providing the following non-exhaustive commissioning certificates for the LPHW installations:
- 01.4.53 Manufacturers and commissioning agents' certificates for:
- System pipework
 - Control Valves
- 01.4.54 The Mechanical contractor shall be responsible for providing the following non-exhaustive commissioning certificates for the domestic hot water services installations:
- 01.4.55 Manufacturers and commissioning agents' certificates for:
- System pipework
 - System Valves TMVs
- 01.4.56 The Mechanical contractor shall be responsible for providing the following non-exhaustive commissioning certificates for the cold water, mains water services installations:
- 01.4.57 Manufacturers and commissioning agents' certificates for:
- System pipework
- 01.4.58 The Mechanical contractor shall be responsible for providing the following non-exhaustive commissioning certificates for ventilation & air conditioning services installations:
- 01.4.59 Manufacturers and commissioning agents' certificates for:
- Mechanical Ventilation Units

- Extract Fans
- Axial Fan
- Destratification Fans
- Dehumidifier
- Dust extract
- Natural Ventilation system and associated controls.
- Hydro Air Conditioning Units
- DX Air Conditioning Units
- System ductwork
- Fire smoke damper system
- Refrigeration design certificates

01.5 System-Specific Testing & Commissioning Procedures

01.5.1 Following the successful completion of pre-commissioning cleaning, the Contractor shall proceed with the detailed testing and regulation of all individual systems.

- Water Systems (Heating & Domestic)
- Pipework Pressure Testing: All domestic hot and cold water services pipework shall be hydrostatically tested to 1,000 kPa (10 bar) and held drop-tight for a duration of 1 hour.
- The Air Source Heat Pump (ASHP) primary heating water circuit shall be tested hydraulically to a pressure of 4 Bar and remain drop-tight for a minimum period of 2 hours.
- Cold Water Storage Tanks:
 - A thorough pre-commissioning visual inspection of the completed tank installation is mandatory prior to filling.
 - A hydrostatic leak test shall be conducted by filling the tank to its maximum capacity and holding it for a minimum of eight hours without leaks.
 - Following the leak test, the tank shall be cleaned, disinfected, and certified. Water samples shall be taken for laboratory analysis to confirm potable water quality.
- Hot Water Calorifier:
 - Full commissioning shall be conducted in line with CIBSE Code W and the manufacturer's instructions. This includes the verification of all safety devices, functional checks of pumps and valves, and regulation of the primary circuit

flow rate. The system shall be cleaned and sterilised to mitigate the risk of Legionella.

- System Balancing:
- The complete heating and domestic hot water return systems shall be hydraulically balanced to achieve design flow rates and temperatures at all terminals and branches. Balancing valves shall be adjusted and locked in their final positions.

01.5.2 Ventilation Systems (Airside)

- Ductwork Leakage Testing:
- Air leakage tests shall be conducted on all ductwork systems in accordance with DW/144:2016.
- Testing must be completed prior to the application of thermal insulation and before access is restricted by ceilings or other building elements.
- In addition to meeting the specified leakage rates, the entire installation shall be free of audible leaks, which must be rectified if detected.
- Fire & Smoke Damper Testing:
- All fire and smoke dampers shall be tested in accordance with BS 9999. The contractor shall perform operational testing, including manual and automatic actuation.
- Testing shall be witnessed by a competent third-party or the fire safety officer and must be completed after the installation of ceilings but before handover.
- Airflow Balancing:
- Airflow measurements and system balancing shall be performed by a qualified commissioning specialist in accordance with CIBSE Commissioning Code A.
- Airflow rates shall be measured and adjusted at all supply, return, and extract terminals to match design values.

01.5.3 DX Air-Conditioning & Heat Pump Systems (Refrigeration)

- Pre-Commissioning Checks: Static checks shall include verification of installation against drawings and ensuring the integrity of the refrigerant pipework via pressure testing with OFN, followed by evacuation to a deep vacuum. Condensate drains shall be water-tested.
- Dynamic Checks: Initial start-up shall verify the correct direction of fan rotation, and the running amperage of all motors and compressors shall be measured and recorded. The final refrigerant charge shall be weighed in. All safety

devices, including pressure cut-outs and leak detection systems, must be functionally tested.

- Performance Testing: Full performance testing shall be undertaken in all operational modes. System operating pressures (suction and discharge), on-coil and off-coil temperatures shall be measured.
- Superheat and subcooling shall be calculated and verified to be within the manufacturer's tolerances.

01.5.4 Soils & Waste Systems

- System Testing: All above-ground soils and waste risers shall be air tested to 38mm water gauge and held for a duration of 3 minutes without loss of pressure. During this test, every connected trap must maintain a water seal of at least 25 mm. All work that will be concealed must be tested before it is enclosed.
- CCTV Inspection: The contractor shall carry out a CCTV inspection for the entire above-ground soils and waste pipework installation, with the recording included in the O&M manuals.

01.6 Seasonal Commissioning

- 01.6.1 The specialist contractor shall carry out seasonal commissioning to verify system performance under varying load conditions. This will involve return visits to site during the first 12 months of operation to check and fine-tune system controls and performance during both heating and cooling seasons. A comprehensive commissioning report, including all test records, calibration certificates, and performance data, shall be submitted as part of the building logbook for final handover.
- 01.6.2 This shall apply to the heating, ventilation, water services, DX Air-Conditioning systems, building management system and will involve return visits to the site during the first 12 months of operation to check and fine-tune system controls and performance during different seasons.

01.7 Water Services - Cleaning, Flushing, and Disinfection

- 01.7.1 The entire water installation (Mains, Cold, and Hot Water Services) shall be thoroughly flushed, cleaned, and disinfected in accordance with BS 8558:2015, BS EN 806-4, HSE L8 (ACOP), and HSG274 Part 2.
- 01.7.2 Pre-Disinfection Flushing: Prior to disinfection, all systems shall be flushed with potable water to achieve a minimum velocity of 1.5 m/s. This is to ensure the removal of construction debris, flux residues, and scale. All strainers must be removed and cleaned after the initial flush.
- 01.7.3 The system shall be filled with a chlorine solution containing:
- 50 mg/l (ppm) free chlorine residual for a contact period of 1 hour, OR
 - 20 mg/l (ppm) free chlorine residual for a contact period of 2 hours.
- 01.7.4 Chlorine shall be introduced at the point of entry and drawn through to every single outlet (taps, showers, TMVs, cisterns, and plant equipment).
- 01.7.5 Concentration shall be verified at the furthest outlet and representative points using calibrated digital meters.
- 01.7.6 After the contact period, chlorinated water must be neutralized using an approved agent before discharge. Discharge is strictly permitted to the foul sewer only; it must never be discharged to surface water.
- 01.7.7 Following final flushing with potable water, samples shall be taken from:
- The incoming mains connection.
 - Cold water storage tanks.
 - The furthest outlets of each branch.
- 01.7.8 All samples must be analysed by an INAB/UKAS accredited laboratory. Testing parameters include: TVC @ 22°C and 37°C, E. Coli, Coliforms, and Pseudomonas Aeruginosa.
- 01.7.9 The system shall not be considered "Handed Over" until a Clear Water Certificate is issued and approved by the Engineer.
- 01.7.10 Post-Handover Water Safety & Monitoring
- The Mechanical Contractor shall include in their tender sum for a mandatory 4-week post-handover flushing and monitoring period. This commences only after the issuance of the "Clear Water Certificate."
 - During this 4-week period, the Contractor shall implement a twice-weekly flushing regime (minimum 2 minutes per outlet) for all hot and cold-water outlets, including TMVs, showers, and plant room wash-down points.
 - Water Safety Logbook: A dedicated on-site logbook must be maintained, recording:
 - Date and time of flush.
 - Unique Outlet ID.
 - Flushing duration.
 - Water Temperatures, Both flow and return/ambient.

- 01.7.11 Any outlet consistently exceeding 20°C (Cold) or failing to reach 50°C (Hot) within one minute shall be reported to the Engineer immediately for investigation.
- 01.7.12 If building occupancy is delayed beyond 7 days following the initial disinfection, the Contractor remains solely responsible for the microbiological integrity of the system.
- 01.7.13 If the Contractor fails to provide logbook evidence of consistent flushing, or if occupancy is delayed beyond the 4-week period, the Engineer may instruct a full system re-disinfection to BS 8558:2015. This shall be carried out at the Contractor's sole expense.
- 01.7.14 Formal handover of water services responsibility to the Client's Facilities Management (FM) team shall only occur upon successful completion of the 4-week flushing period and formal sign-off of the Water Safety Logbook.

01.8 Witnessing & Handover

- 01.8.1 The Contractor shall provide a written schedule with a minimum 10-working day notice period of proposed test dates for witnessing by the Engineer. No less than 24 hours prior to the scheduled witness test, the Contractor must provide written confirmation that all their own pre-testing is complete and satisfactory. The Engineer will not attend without this confirmation. Upon successful completion and sign-off, the Contractor shall provide a client demonstration and training on system operation.
- Fans
 - Air terminals
 - Volume Control Dampers
 - Commissioning Valves/sets
 - DX Air Conditioning System
 - DX Air Conditioning System
 - HVAC Building Management Controls

01.9 Documentation

01.9.1 Upon project completion, the Contractor shall provide a comprehensive suite of documentation, including but not limited to:

- Complete Operation and Maintenance (O&M) manuals in both hard copy and electronic formats.
- Detailed "as-installed" drawings.
- A complete set of signed and dated commissioning test sheets for every system.
- Pipework pressure test certificates.
- Certificates of conformity for system cleanliness, including flushing records and bacteriological test results.
- Refrigerant leakage test certificates.
- CCTV inspection recordings for soils and waste systems.
- A comprehensive commissioning report summarising all activities and verifying that systems meet the design requirements.
- HVAC End User BMS Control Manual.

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02.2 Standards

- 02.2.1 All goods, products and materials shall be in accordance with the latest revision of Irish and EU Standards.
- 02.2.2 The Mechanical Contractor shall carefully read the notes on the drawings and include for all associated costs in his tender.
- 02.2.3 All future maintenance resulting in replacement parts, shall confirm with specification to ensure a coherent / consistent installation.
- 02.2.4 All future maintenance of 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.

02.3 General

- 02.3.1 The contractor shall be responsible for the **COMPREHENSIVE 12 MONTH MAINTENANCE** of all plant and equipment installed under this contract. The contractor shall implement a complete Planned Preventative Maintenance regime and shall schedule regular maintenance visits to ensure the optimal operation of the plant maximising opportunities for energy efficiency and extending plant life.
- 02.3.2 Planned Preventative Maintenance shall be undertaken to achieve best operational practice and shall as a minimum reflect the guidelines outlined by CIBSE and BSRIA.
- 02.3.3 A key objective of the Planned Preventative Maintenance regime, in addition the optimisation of the plant performance and life of plant is to maximise the energy efficiency of the services installations. The contractor shall make specific reference to CIBSE Guide F “Energy Efficiency in Buildings”. The contractor shall tailor maintenance regimes in accordance with guidance offered in Guide F and provide a holistic approach to plant maintenance and energy efficient operation of the building services installations.
- 02.3.4 The planned preventative maintenance shall be deemed to be fully inclusive of all labour and parts for the duration of the 12-month maintenance period. The only exception being in respect of components which have failed due to improper use by the operator. In the event that the operator has been fully trained in the proper use, or where damage has occurred outside the control of the contractor, a claim for further costs shall be considered by the client.
- 02.3.5 The contractor shall be responsible for underwriting the safe and efficient operation of all the installed systems and shall where necessary (or where required by code of practise or legislation) engage the services of a specialist to undertake the maintenance.
- 02.3.6 The contractor shall recognise the importance of maintenance and ensure that the 12-month maintenance costs are clearly identified within his tender return. **The contractor should include an outline maintenance plan as an appendix to the tender return documents.** This appendix should clearly indicate how the contractor arrived at the 12-month maintenance costs as included within returned summary of tender. The appendix should also include proposed manpower levels and frequency of service visits included.

02.4 Personnel

- 02.4.1 The contractor shall have in place, the appropriate suitably qualified personnel to manage and implement the maintenance of the installation. These suitably qualified personnel shall be assembled prior to practical completion. The Engineer and the building Managers shall be provided with an organisational chart indicating the names and details of the contractors appointed personnel.
- 02.4.2 The contractor's maintenance personnel shall attend the entire handover and maintenance seminar for all disciplines and trades. The contractor shall ensure that the maintenance personnel fully versed in all aspects of the building operation.
- 02.4.3 The contractor shall **NOT** be permitted to change any member of this maintenance team without written acceptance of the building Manager and the Engineer.

02.5 Plant & Equipment Warranties

- 02.5.1 The contractor shall provide a **12 MONTH WARRANTY** on all plant and equipment. The warranty shall be fully endorsed by the relevant manufacturers and shall guarantee all labour and component costs associated with the repair or replacement of failed plant or components thereof.
- 02.5.2 The contractor shall note that the lifecycle costs of plant and components must be considered when selecting plant and equipment and shall fully understand the consequences in terms of warranty and maintenance.
- 02.5.3 The maintenance regime shall reflect the expectations of the plant manufacturers and the Engineer to ensure that the plant warranty, plant life and energy efficiency is optimised.
- 02.5.4 In addition to the contractors warranty all plant and components shall be selected and shall be provided with manufacturers warranties in accordance with the following schedule (the following list is not exhaustive).
- 02.5.5 The contractor shall present written confirmation from the various suppliers on the life expectancy of all systems and system components. This confirmation shall be presented with the procurement schedule and shall be reviewed as part of the Engineer's approval

Item	Plant or System	Minimum Life Expectancy	Notes
1.0	Primary Plant	15 years	
1.1	Fans	15 years	
1.2	Air Conditioning Plant	20 years	
1.3	Heat emitters	10 years	
1.4	Valves	20 years	

02.6 Maintenance Schedule

- 02.6.1 The contractor shall be responsible for the formulation and presentation of a complete maintenance programme, outlining the maintenance requirements of each plant component. The maintenance programme shall detail all service intervals for the maintenance of all plant and equipment. The maintenance schedule and the service intervals shall be agreed with the manufacturers and shall comply in full with the manufacturer's best practice. Where necessary, the contractor shall include for manufacturers specialist engineers to attend site to undertake their prescribed maintenance. All costs associated with attendances from specialists shall be included in the maintenance costs.
- 02.6.2 The maintenance programme for plant shall take account of expected high demand periods and shall be programmed that plant is always available to run when the demand is highest, and a periods of maximum efficiency. All planned plant down time shall be scheduled where there is no impact on the day-to-day building operation e.g. Heat Pump maintenance shall take place outside the heating season. All down times shall be agreed with the building managers.
- 02.6.3 The contractor's proposal shall clearly stipulate daily, weekly and monthly maintenance requirements categorising them in terms of critical and recommended tasks.
- 02.6.4 The building operator shall have an appointed member of staff tasked with co-ordination of the contractors and also with responsibility for daily monitoring and visual inspection of plant.

02.7 Testing & Inspections

- 02.7.1 The Contractor shall be responsible for a carrying out all, testing and inspections as required by the specification or by any governing regulations or codes of practice not referenced in the specifications.
- 02.7.2 The Contractor shall maintain an accurate documented record of all maintenance 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 All life safety systems where legislative mandatory inspection and testing is required to be carried out shall be completely and verifiably recorded and certificates of maintenance undertaken shall be presented to the building operator for inspection by visiting Fire Officers or insurers.

02.8 Reporting and Logging

- 02.8.1 Following each scheduled and unscheduled maintenance visit, the building facilities manager shall be provided with a copy of the maintenance technician's site. The technicians report shall clearly describe the maintenance undertaken, highlighting any remedial action required.
- 02.8.2 In addition to the above, the contractor shall provide a twice yearly report outlining the maintenance to be undertaken in the following six-month period and synopsising the maintenance undertaken in the previous six months. The report shall highlight any known problems and shall illustrate what remedial action has been put in place. The report shall track previously highlighted problems, provide an update on progress and clearly highlight where a previous problem has been rectified.
- 02.8.3 The contractor's twice yearly report shall be presented no later than three weeks after the six-month period inspection. The contractor shall then attend a review meeting to discuss the content of the report, and all other general building and energy performance related issues.
- 02.8.4 The Contractor shall record all maintenance visits and service reports in a dedicated section of the Operation and Maintenance Manual. The record shall be maintained on site for review or inspection by the Engineer or client's representative.

02.9 Calibration of Plant

- 02.9.1 At regular intervals and as part of the Planned Preventative Maintenance programme the contractor shall routinely review the commissioning data and check any drifting in system operation and performance from that data. Any elements which have been found to have drifted shall be re-calibrated and tested to ensure the plant or systems are operating within optimum thresholds.

02.10 Energy Management

- 02.10.1 Energy management shall be considered as a prime focus of the Planned Preventative maintenance policy and should be reflected in the contractors detailed maintenance plan. Optimum operation of plant and equipment is clearly understood to result in reduced energy consumption and as such the contractor is directed to examine CIBSE and BSRIA Energy saving guidelines which are directly related to the maintenance and operation of the building.
- 02.10.2 The building has been designed to take cognisance of energy "benchmarks" and shall be monitored by the contractor to ensure optimal operation to ensure that the building is achieving the benchmark results.
- 02.10.3 Opportunities for further energy savings are to be highlighted for review by the Engineer and Building operator.

02.11 Review Procedures

- 02.11.1 As well as the twice yearly review meetings the contractor shall be assessed in terms of the delivery of services and attention to detail in respect of the ongoing maintenance. In the event that the contractor is found to be failing in terms of the level of service and the quality of maintenance being undertaken and following a period that may be granted to improve an alternative contractor may be engaged to complete these works and any / all associated costs shall be deducted from outstanding accounts or retention.

02.12 Delineation of Responsibilities

- 02.12.1 The contractor shall be responsible for the complete maintenance of the entire Mechanical installations **FOR A 12 MONTH PERIOD** including that of specialist systems provided under the terms of the installation contract.
- 02.12.2 The building operator shall be responsible for daily visual inspections at a superficial level and shall advise the contractor of any reportable observations. The contractor shall be responsible for all other maintenance as set out in an agreed maintenance plan.

02.13 Emergency Call Out

- 02.13.1 The contractor shall commit to provide a quantity of unscheduled Emergency call-outs response within **FOUR HOURS** of notification. Next day response may be acceptable for less critical issues.
- 02.13.2 The contractor shall include for **4 No. EMERGENCY CALL-OUTS** annually and should note that out of hours attendance may be required.
- 02.13.3 The contractor shall advise a rate for extra over call outs as may be requested by the operator. Where a call out has been requested as a result of defective component or because of lack of maintenance the contractor shall not be entitled to any associated call out costs.

02.14 Service Agreement

- 02.14.1 The scope of the services agreement shall be developed between the contractor and manufacturers of specialist plant and equipment. Maintenance schedules shall be developed to identify and schedule all maintenance requirements. The following is to be used for **GUIDANCE ONLY** and should be expanded or reviewed in accordance with manufacturer's guidelines as set out in O&M manuals.

Plant (Location)	Item	Period- Daily/ Weekly	Quarterly	Twice Yearly	Annually
LPHW Pipework & Assoc. Systems		Inspection (R)	Inspect pipework (R)	Check/Empty Strainers (C)	Re-Commission (R)
Heat Recovery Units		Inspection (R)	Check / Replace filters (R)	Check / Replace filters (C)	Full service of all parts (C)
Extract Fans		Inspection (R)			Full service of all parts (C)
Fire & Smoke / Fire Dampers		Inspection (R)			Full service of all parts (C)
DX Air conditioning plant		Inspection (R)			Full service (C)
Electrical Switchgear		Inspection (R)			Full service check of all comp. (C)
Lighting Control System				Inspection (R)	Full service check of all comp. (C)
Emergency Lighting		Inspection (C)	Test and replace lamps etc. (C)	Test and replace lamps etc. (C)	Test and replace lamps etc. (C)
Fire Alarm System		Inspection (C)	Test and Clean Sensors (C)	Test and Clean Sensors (C)	Test and Clean Sensors (C)
Power Factor		Inspection (R)			Inspection and Service (R)
UPS		Inspection (R)	Inspection and Service (R)	Inspection and Service (R)	Inspection and Service (C)
Suggested Maintenance Categories: Critical (C) Recommended (R)					

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05.1 Existing Services – General

- 05.1.1 The Contractor shall be fully responsible for identifying all existing services at the proposed Roscommon University Hospital.
- 05.1.2 The Contractor shall be aware of the full project intentions which include services replacement and maintaining of selected services within the building.
- 05.1.3 Any reinstatement of removed services where the Contractor has not identified and made safe services to be retained will be fully at the Contractors expense.
- 05.1.4 The Contractor shall be responsible for making safe and diversion of existing services in advance any works. The Contractor shall set out a complete method statement for all diversion and disconnection works. The contractor is particularly advised to examine the site during the tender period and ascertain the full extent of these works.
- 05.1.5 The Contractor is specifically advised and shall be deemed to have surveyed the full extent of strip – out and diversions, as well as items to be disconnected / reconnected, during the Tender period and all costs are deemed included in the Tender return. No future claims in this regard will be entertained. The Contractor shall refer to all survey and existing layout drawings provided and shall consult these during his own survey. Any discrepancies shall be advised by the Contractor and included in the tender.
- 05.1.6 The Contractor will be required to liaise with the Client representative before commencing the strip-out works. Any materials or equipment that may be deemed to be of value are to be carefully removed and assessed with the Client. If deemed that the Client wishes to retain any items, the Contractor shall transport the items to an agreed storage location within 30km of Roscommon University Hospital. Only when confirmed that the Client does not wish to retain items of plant or equipment shall the Contractor arrange for the appropriate disposal of redundant / removed equipment.
- 05.1.7 The following photographs are provided as supplementary information only. Provision of these images shall not defer from the responsibility of the Contractor to undertake his own survey.
- 05.1.8 All work shall be carried out in an environmentally aware manner in order to minimise any adverse environmental impact caused by the works.
- 05.1.9 The contractor shall take all due care when carrying out this project to carry out the works in an environmentally aware manner and dispose of all redundant materials in an environmentally responsible manner, including the use of recycling or specialist disposal methods to avoid the release of pollutants to the environment. Please note that useable redundant materials or valuables found during strip out works will be required to be presented to the client for review.
- 05.1.10 All redundant materials containing material classified under 'European Communities Waste Management Act, 1972' and 'S.I. No. 73/2000 – Waste Management (Hazardous Waste) (Amendment) Regulations, 2000' shall be considered as hazardous waste and shall be disposed of in accordance with legislative requirements.

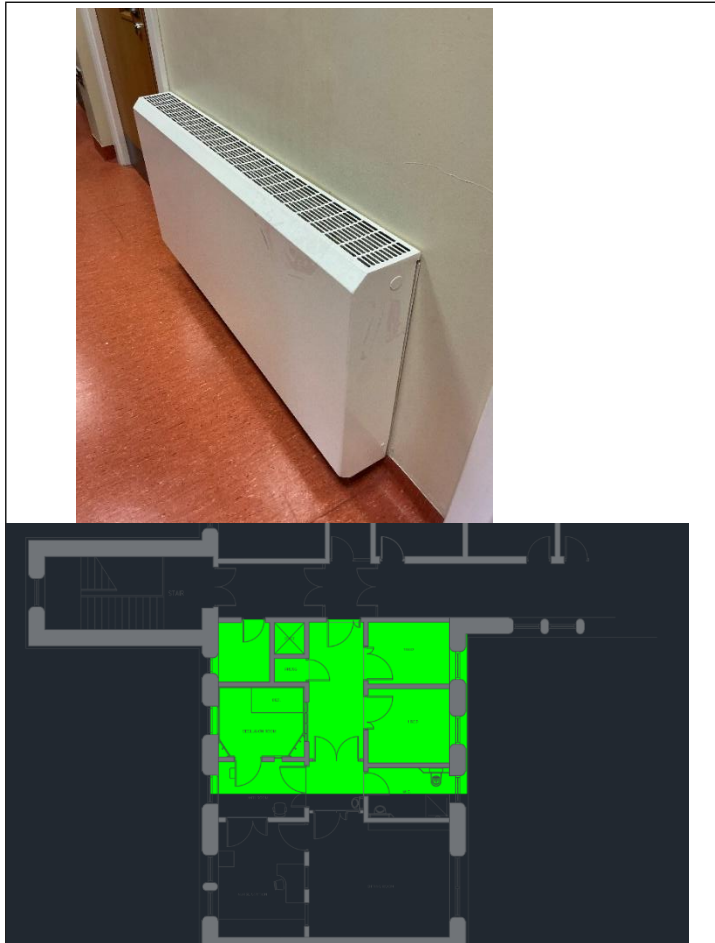
- 05.1.11 The Contractor shall ensure that approved methods are strictly adhered to by the site installation team and no deviation from approved materials, or methods will be permitted.
- 05.1.12 In the event that the Contractor encounters an issue preventing him from proceeding with approved methods, they must stop work and must engage with the client's representative or the Engineer until a resolution is found and works can proceed.
- 05.1.13 The Contractor shall make provisions within his programme and allowances within his tender for elements of unforeseen works that may be required and for disruption that may be caused where resolutions require further engagement with, and the approval of the ER.
- 05.1.14 The Contractor shall be expected to form an opinion based on experience, during tender stage site visits and shall include any necessary costs within his tender sum. No claims shall be entertained in respect of delays, disruptions, or additional works as a result of restrictions or any other implications.

05.2 Existing Services – Summary Scope

- 05.2.1 The contractor shall include for all existing mechanical services to be connected to existing system unless otherwise stated. Contractor shall include for removal of all obsolete mechanical services from site unless otherwise stated. Contractor shall request approval from design team to remove certain equipment from site. The redundant items of equipment/building materials shall be removed from site by the contractor and disposed of in an approved manner complying with current health & safety and environmental health regulations.
- 05.2.2 The summary scope of work relating to existing services outlined below is for further assessment by the Contractor who is expected to apply industry knowledge and the experience of a competent contractor to fully establish an account for all necessary works.
- 05.2.3 The Contractor shall refer to all survey reports and existing layout drawings provided as part of tender information and shall consult these during his own survey. Any discrepancies shall be advised by the Contractor and included in the tender.
- 05.2.4 The following photographs are provided as supplementary information only. Provision of these images shall not defer from the responsibility of the Contractor to undertake their own survey.



05.3 Existing Services – Reference Photographs

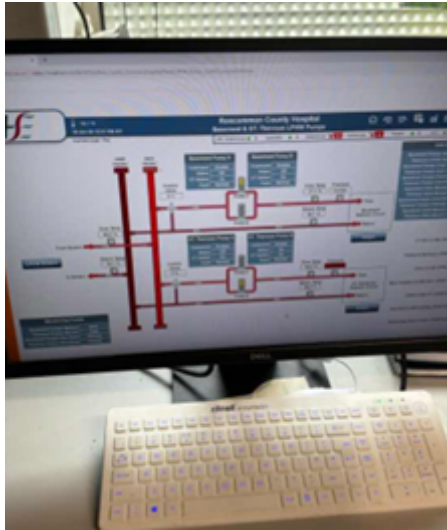
	Contractor shall include: For connecting 15mm HTG F&R into existing pipework in the lower ground floor level below serving existing radiator to be removed and routing new pipework up to ceiling void to serve the new radiant panels. All systems shall be safely decommissioned before removal. Coordinating with the architectural demolition layouts, the Contractor shall completely strip out and dispose of all redundant services in areas of full refurbishment, including: This work must be fully coordinated with the wider layout changes and demolitions proposed for the area on the ground floor. Contractor to complete survey to ensure strip out does not effect other areas. Contractor to allow for alteration to prevent distribution to other rooms.
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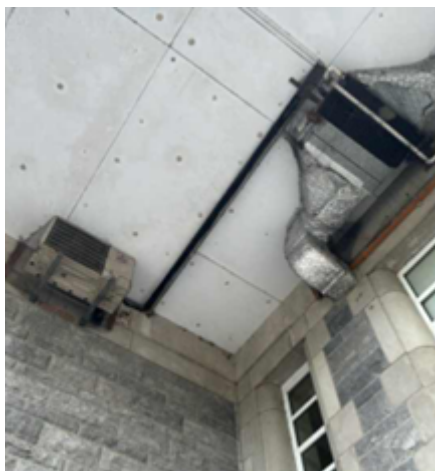
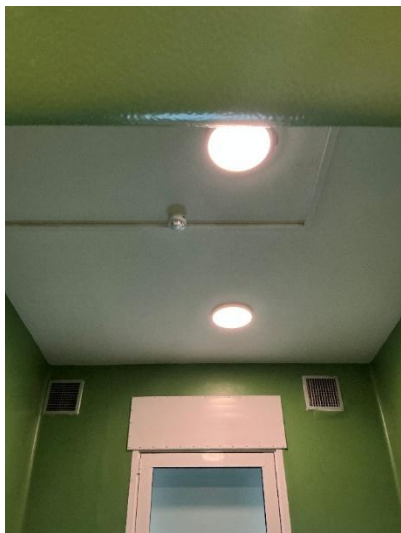
Contractor to allow for the removal of the existing radiator within the anti-room



The Contractor is to allow for the removal and reinstating of the existing clinical sink in this location to allow for IPS panel installed to route new services up behind the sink.



Contractor to allow for a survey of the existing MCC Panel and allow for connecting / linking of new plant to existing MCC Panel.



Existing Grilles and Ductwork along with existing AC system to be stripped out in seclusion room to accommodate for new Mechanical & Electrical Installation and proposed room layout.

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11.1 Outline Description

- 11.1.1 The Contractor shall be responsible for the supply, installation, and testing of the complete heating services systems as detailed on IN2 Engineering Design Partnership drawings.
- 11.1.2 The following outlines the Contractor's scope of works, which includes, but is not limited to:
- 11.1.3 Supply and Installation of all heat emitters, heating commissioning sets, and heating valves.
- 11.1.4 Pipework and Distribution:
- Supply and Installation of the complete heating control valve strategy, including motorised control valves, PICV, TRV etc.
 - Supply and Installation of Radiant Panel & Heating Emitters.
 - Supply and Installation of all distribution pipework, including but not limited to, valves, fittings, insulation, cladding, and mechanical supports.
- 11.1.5 Supply and Installation of pressure and temperature gauges.
- 11.1.6 Ancillary Works:
- 11.1.7 Pipework insulation.
- 11.1.8 Labelling and tagging of pipework and equipment.
- Testing, flushing, and commissioning of the complete heating services and system.
 - Handover documentation.
- 11.1.9 The Contractor shall be responsible for the complete design, selection, and installation of all service support and bracketry systems, including but not limited to plinths, proprietary support systems, anchor systems, and metal framing supports. All components of the service support system shall be sourced from a single manufacturer to ensure system compatibility and accountability. The Contractor shall determine the appropriate components, materials, and installation methods based on the fully loaded capacities of the proposed systems/equipment, with a minimum safety factor of 1.5 (50% over design load), and the structural integrity of the mounting surface. Support system hangers shall be spaced at intervals not exceeding those specified in the relevant services sections of this specification. The installed support system shall exhibit minimal deflection under full load between supports. The Contractor shall meticulously consider all relevant factors when selecting support systems and shall reduce support spacing as necessary to ensure structural stability. Support spacing shall not be increased beyond the specified limits. Additional supports shall be provided at intersections and changes in direction to maintain structural integrity.
- 11.1.10 The Contractor shall provide detailed calculations and design documentation for all MEP support systems, including anchor and fixing details, from the selected single manufacturer, for review and approval by the Structural Engineers. These calculations shall demonstrate the structural adequacy of the proposed support systems under all loading conditions. The Contractor shall allow for and execute "pull-out" testing of anchors and fixings on-site, as directed by the Structural Engineers, to verify the suitability of selections based on actual site conditions.

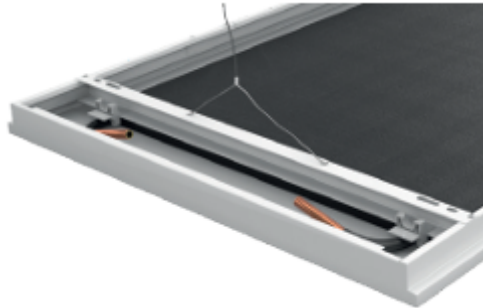
- 11.1.11 The Contractor shall thoroughly review and understand all notes and specifications provided within the contract documents, including those shown on the drawings. The Contractor shall include all associated costs related to the service support systems within their tender submission.

11.2 Standards

- 11.2.1 The heating pipework installations shall comply with the requirements of the following standards:
- BS EN 1264-3:2021 – Water based surface embedded heating and cooling systems – Dimensioning:
 - EN 1264-4:2021: Water based surface embedded heating and cooling systems. Installation
 - BSRIA Guide Pre-commission Cleaning of Pipework Systems (2nd Edition):
 - BS EN 442 Radiators and convectors - Technical specifications and requirements
 - BS EN 14037: Ceiling mounted radiant panels supplied with water at temperature below 120 °C.
 - BS EN 16430: Fan assisted radiators, convectors and trench convectors
 - DIN 18032: Ball-impact resistance
 - BS 7593: Code of practice for the preparation, commissioning and maintenance of domestic central heating and cooling water system
 - VDI 2035: Prevention of damage in water heating installations - Water quality
 - ISO 3741:2010: Determination of sound power levels of noise sources using sound pressure

11.3 Equipment

11.3.1 Radiant Panels



- 11.3.1.1 Radiant ceiling panels shall be modular units designed for both heating and cooling applications, suitable for installation in rooms with ceiling heights from approximately 2 m to 4 m.
- 11.3.1.2 Construction: Panels shall be constructed from a galvanised steel sheet with special clip profiling that embeds four to twenty externally galvanised precision steel tubes. The panel must be statically reinforced using chamfers, duplications, and clinched joints to allow for suspension centre distances of up to 3 m. The connection between the heating pipes and the radiant plate must be a continuous mechanical dry-clinch joint to ensure maximum heat transfer and allow for differential thermal expansion without noise (creaking).
- 11.3.1.3 Materials:
- Radiant Plate: Fully galvanised, polyester-coated sheet steel with a maximum thickness of 0.45 mm.
 - Tubes: Externally galvanised precision steel tubes with an external diameter of 15 mm and a wall thickness of 1 mm, compliant with DIN EN 10305-3. The internal pipe diameter shall not exceed 13 mm.
 - Radiant panel shall be provided with a Suspension kit for the ceiling
 - Headers/Collectors: Externally galvanised round pipe with an outer diameter of 30mm.
- 11.3.1.4 Performance:
- Operating Pressure: Suitable for a maximum operating pressure of 12 bar.
 - Operating Temperature: Suitable for a maximum operating temperature of 83°C.
 - Water Quality: The system must be operated with water in accordance with VDI 2035
 - Fire Safety: All components must comply with building material class A1 in accordance with EN 13501-1.
- 11.3.1.5 While the panels shall be capable of 120°C (as per BS EN 14037), the system design is based on the primary flow of Flow 80°C & Return 60°C. The Contractor must ensure panel sizing is based on these mean water temperatures

- 11.3.1.6 The visible side of all panels shall have a high-quality polyester powder coat finish. The final colour is to be selected by the Architect. Prior to ordering, the Contractor shall submit physical RAL colour swatches for approval. For tendering purposes, all pricing shall be based on non standard RAL Colour
- 11.3.1.7 Panels shall be supplied with factory-fitted acoustic insulation consisting of mineral wool coated on both sides with glass matting. The insulation shall be 40 mm thick with a thermal conductivity (λ) of 0.035 W/mK.
- 11.3.1.8 End covers shall be fitted to conceal header connection points, powder coated in the same colour as the panel.
- 11.3.1.9 Dust Protector Panel shall be provided; panels shall be sealed with a galvanised steel dust protector panel.
- 11.3.2 Panels shall be supplied with ceiling frame to suit proposed ceiling type
- 11.3.3 Panels shall be supplied with suspension kits
- 11.3.4 Heating Control Strategy:
- System Integration and Functionality: The heating system shall be fully integrated with the Building Management System (BMS) to provide comprehensive monitoring, control, and data logging capabilities. All room temperature control shall be managed by the BMS via dedicated room temperature sensors.
 - Room Temperature Monitoring and Trend Logging: The BMS shall continuously monitor and record room temperature data from each heating zone using dedicated room temperature sensors. Room temperature trend logs shall be generated and stored within the BMS for analysis and optimisation.
 - Occupied Mode Control: During normal occupied time schedules, as defined within the BMS time schedule, the BMS shall regulate the heating system to maintain a target room temperature of 21°C. The BMS shall achieve this by modulating the motorsied zone valves based on feedback from the room temperature sensors.
 - Out-of-Hours Mode Control: During out-of-hours' time schedules, the BMS shall automatically set back the target room temperature to 16°C (adjustable). This setback shall be implemented to minimize energy consumption while maintaining a reasonable level of comfort.
 - Holiday Mode Control: When holiday mode is activated within the BMS, the target room temperature shall be set to 16°C. This mode shall be used for extended periods of building inactivity.
 - The BMS shall continuously monitor the status of each heating zone valve The BMS shall generate and transmit alarms in the event of actuator failure or malfunction, enabling prompt maintenance and repair.
 - The BMS shall monitor and record the flow temperature of the heating system. This data shall be used to optimise system performance and identify potential issues.

11.4 Construction Products Regulations

- 11.4.1 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.
- 11.4.2 All products where applicable must comply with relevant Harmonised European Standards (hENs)
- 11.4.3 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.
- 11.4.4 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.
- 11.4.5 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.
- 11.4.6 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.
- 11.4.7 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.

11.5 Samples & Technical Submittals

- 11.5.1 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.
- 11.5.2 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.
- 11.5.3 The contractor shall be responsible for determining quantities from IN2 Engineering Design Partnership drawings and specifications.
- 11.5.4 The contractor shall liaise with the various specialist suppliers to ensure that all necessary fixings kits, supports, connections, etc. are included.
- 11.5.5 The contractor shall refer to IN2 Engineering Mechanical Specification, Section M00 General specification.
- 11.5.6 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.

11.6 Approved Manufacturers and Vendors

- 11.6.1 The following manufacturers may be considered for the provision of the heating emitters.
- 11.6.2 Ceiling Radiant Panels
- Zehnder Carboline as supplied by Versatile Heating Systems or equivalent.
- 11.6.3 All equipment and ancillary components must be selected from the same manufacturers range.
- 11.6.4 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 Employer Representative determination and written Employer Representative 'approval', which may be refused

11.7 Installation

- 11.7.1 The emitters shall be located as on IN2 Engineering Design Partnership M10 series drawings.
- 11.7.2 The Contractor shall be responsible for ensuring pre-painted/finished emitters are protected during the construction phase. Any damaged equipment will be replaced at the contractor's expense.
- 11.7.3 The Contractor shall include for all necessary ancillary components to facilitate the successful installation of the emitters. The contractor will be deemed to have familiarised themselves with these requirements prior to tendering.
- 11.7.4 The Contractor shall allow for erecting all emitters twice and dismantling once, to suit other trades.
- 11.7.5 All final electrical connections (where applicable) to be made by supplier at expense of 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.
- 11.7.6 Prior to placing an order, the Contractor shall verify the dimensions of all emitters and pipework connectors relative to the indicated location, size, co-ordination with other services and local building restrictions.
- 11.7.7 Radiant Panels
- 11.7.8 The Contractor is responsible for the full coordination and installation of the radiant ceiling panels. Prior to ordering, the Contractor shall:
- Coordinate with the radiant panel manufacturer to ensure the proposed system can be installed at the specific angles agreed with the Architect.
 - Ensure the manufacturer's design includes all necessary provisions for venting and system balancing to prevent air locks and ensure correct hydraulic performance.
 - Submit detailed manufacturer's workshop drawings, including panel layouts, installation details, suspension methods, and connection configurations, to the

Engineer and Architect for review and comment. No orders shall be placed until these drawings are approved.

- 11.7.9 The erection of all radiant panels, including all suspension kits, brackets, and supports, shall be the responsibility of the Contractor.
- 11.7.10 The Contractor shall coordinate the installation programme and ceiling interfaces with the Specialist Ceiling Contractor to ensure seamless integration. All necessary supports, flanges, and hangers for recessed installations shall be included.
- 11.7.11 Panels must be installed at the angles shown on the approved workshop drawings. The suspension axes allow for an angled fitting of up to 45° across the length and 30° across the width. The contractor must verify that the selected fixing kit is suitable for the specified angle.
- 11.7.12 Upon completion of the installation and filling of the system, the Contractor shall carry out a full thermal imaging survey of all radiant panels. A formal thermal imaging report, complete with photographs and analysis, shall be issued to the Engineer. This report must verify that the panels are operating correctly and confirm that there are no air locks present in the system.

11.8 Testing & Commissioning

- 11.8.1 Pre-Commissioning Checks: Prior to pressure testing and commissioning, the following checks shall be carried out:
 - Verification of the installation against the design drawings and specifications.
 - Visual inspection of all pipework and emitters for damage or defects.
 - Verification of correct pipework connections.
 - Verification of the correct installation and wiring of control systems, pumps, and valves.
 - Verification of the floor screed curing time according to the manufacture's specifications.
- 11.8.2 The test pressure shall be maintained for a minimum duration of 48hrs. No pressure drop shall be observed during the test period. Test results shall be documented and provided to the engineer / client.
- 11.8.3 The entire heating system, pipework, shall be pressure tested after installation.
- 11.8.4 The test pressure shall be 1.5 times the maximum operating pressure or as required by relevant standards.
- 11.8.5 Cleaning and Chemical Treatment, the system shall be flushed, cleaned, and inhibited in accordance with BSRIA BG 29/2021. The Contractor shall provide a water quality certificate from an independent laboratory confirming compliance with VDI 2035 (specifically regarding pH, conductivity, and hardness) to protect the ASHP heat exchanger and aluminium/steel components
- 11.8.6 The heating system shall be thoroughly flushed to remove any debris or contaminants. The flushing process shall be documented.
- 11.8.7 Commissioning data shall include for measured water flow rates to each individual heating emitter.
- 11.8.8 The flow rate within each heating emitter must be adjusted to align with the heating design specifications, ensuring the intended thermal output for each zone.

- 11.8.9 Balancing results shall be documented and provided to the client.
- 11.8.10 Thermal Performance Verification:
- 11.8.11 The contractor shall provide a comprehensive thermographic survey report. This must include high-resolution thermal images of all radiant panels and UFH zones while at steady-state operating temperature. The report must demonstrate a uniform surface temperature distribution with no anomalies (cold spots or air pockets) and verify that pipe spacing matches the design layout.
- 11.8.12 Any temperature variance exceeding 3°C across a single emitter surface (indicative of air locks or debris) must be rectified and re-surveyed.
- The system must have been running for at least 4 hours (for UFH) or 45 minutes (for radiant panels) to ensure the surface has reached operating temperature.
 - The floor or panels must be clear of debris, tools, or coverings that would mask the thermal signature.
 - There should be a sufficient temperature difference (at least 10°C) between the heating medium and the room's ambient air to get a clear "high-contrast" image

11.9 Labelling

- 11.9.1 Pipework Identification: All pipework shall be clearly identified using self-adhesive coloured bands at intervals not exceeding 3 meters. Bands shall be placed at valve or expansion joint locations, duct or building inlet and exit points, and on either side of wall or floor penetrations. Identification shall adhere to BS 1710: 2014, with colours conforming to BS 4800: 2011.
- 11.9.2 The service name shall be indicated on a worded identification band located in a visible position, along with an arrow showing the direction of flow. Flow and return mains shall be identified with the letter's "F" or "R," respectively, appended to the service name.
- 11.9.3 Suppliers shall be requested to label all equipment and packages with identification numbers, to ensure items can be correctly identified.
- 11.9.4 All equipment, valves, and fittings shall be individually numbered and identified using durable "traffo labels" securely affixed. A protected valve chart with a permanent finish, detailing the positions and numbering of all valves, shall be installed in an agreed-upon location.

11.10 Documentation

- 11.10.1 Upon project completion the contractor shall provide complete Operation and Maintenance instructions with "As installed" drawings. (If applicable, otherwise remove)
- 11.10.2 The contractor shall provide the following documentation for all emitter installations. (If applicable, otherwise remove)
- Manufacturer's test conformance sheets.
 - Complete pressure test results indicating:
 - Date of test.
 - Test pressure.
 - Duration of test.
 - Signatures of the contractor's witness and engineers' representative witness.
 - Complete commissioning results indicating:
 - Date of commissioning
 - Design flow rates and pressure drops
 - Commissioned flow rates and pressure drops
- 11.10.3 The Contractor shall provide a complete O&M manual including:
- VDI 2035 Water Analysis Report.
 - BSRIA BG 29/2021 Cleaning and Flushing Logs.
 - 6-Bar/24-Hour Pressure Test Certificates (Signed by Contractor and Witness).
 - Thermographic Survey for all Radiant Panels and UFH Zones.
 - As-Installed Drawings showing precise circuit lengths and Emitter locations, valve arrangements etc.
 - The contractor shall provide the manufactures commissioning documentation.
 - The contractor shall provide the BMS control documentation.
 - The contractor shall provide the flow rate calculations for each heating emitter, and for the complete heating system.
 - The contractor shall provide the 24-hour pressure test documentation.
- 11.10.4 The contractor shall provide "As installed" drawings of the heating system.
- 11.10.5 The contractor shall provide the manufactures commissioning documentation.
- 11.10.6 The contractor shall provide the BMS control documentation.
- 11.10.7 The contractor shall provide the flow rate calculations for each heating emitter.
- 11.10.8 The contractor shall provide the 24-hour pressure test documentation.

11.11 Extra Materials

11.11.1 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.

- 2 No. Automatic Air Vents
- 2 No. Air bleed valve keys.

11.12 Appendix A: Schedule of Radiant Panels

11.12.1 Contractor shall refer to M10 Layouts, Schematic Drawings and IN2 Schedules

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12.1 Outline Description

- 12.1.1.1 The Mechanical Contractor shall be responsible for the supply, installation, and testing of the complete heating services systems as detailed on IN2 Engineering Design Partnership drawings.
- 12.1.1.2 The following outlines the Mechanical Contractor's scope of works, which includes, but is not limited to:
- 12.1.1.3 Supply and Installation of the complete heating control valve strategy, including motorised control valves, etc.
- Supply and Installation of heating emitters & Radiant panels.
 - Supply and Installation of all distribution pipework, including but not limited to, valves, fittings, insulation, and mechanical supports.
- 12.1.1.4 Ancillary Works:
- Pipework insulation.
 - Labelling and tagging of pipework and equipment.
 - Testing, flushing, and commissioning of the complete heating services and system.
 - Handover documentation.
- 12.1.1.5 Low Pressure Hot Water (LPHW) Circuits: The Heating Pipework Installations shall include threaded steel pipework up to 50mm and over 50mm shall be welded steel pipework circuits for the following LPHW systems:
- Constant Temperature Radiant Panel Heating Circuits, designed for a flow temperature of 80°C and a return temperature of 60°C.
- 12.1.1.6 The Contractor shall be responsible for the supply and installation of all pipework and plant as indicated on the IN2 Engineering Design Partnership drawings.
- 12.1.1.7 All motorised valves shall be provided as free issue by the BMS Controls Contractor (unless otherwise specified) and installed by the Contractor. The BMS Controls Contractor, as the specialist, shall be responsible for sizing all heating control valves in coordination with the proposed valve manufacturer. The valve manufacturer shall review all design drawings and map out the system and provide recommendations for any proposed changes to ensure precise system commissioning in conjunction with the contractor's commissioning specialists.

- 12.1.1.8 The Contractor shall be responsible for the complete design, selection, and installation of all service support and bracketry systems, including but not limited to plinths, proprietary support systems, anchor systems, and metal framing supports. All components of the service support system shall be sourced from a single manufacturer to ensure system compatibility and accountability. The Contractor shall determine the appropriate components, materials, and installation methods based on the fully loaded capacities of the proposed systems/equipment, with a minimum safety factor of 1.5 (50% over design load), and the structural integrity of the mounting surface. Support system hangers shall be spaced at intervals not exceeding those specified in the relevant services sections of this specification. The installed support system shall exhibit minimal deflection under full load between supports. The Contractor shall meticulously consider all relevant factors when selecting support systems and shall reduce support spacing as necessary to ensure structural stability. Support spacing shall not be increased beyond the specified limits. Additional supports shall be provided at intersections and changes in direction to maintain structural integrity.
- 12.1.1.9 The Contractor shall provide detailed calculations and design documentation for all MEP support systems, including anchor and fixing details, from the selected single manufacturer, for review and approval by the Structural Engineers. These calculations shall demonstrate the structural adequacy of the proposed support systems under all loading conditions. The Contractor shall allow for and execute "pull-out" testing of anchors and fixings on-site, as directed by the Structural Engineers, to verify the suitability of selections based on actual site conditions.
- 12.1.1.10 The Contractor shall thoroughly review and understand all notes and specifications provided within the contract documents, including those shown on the drawings. The Contractor shall include all associated costs related to the service support systems within their tender submission.

12.2 Standards

- 12.2.1 The heating pipework installations shall comply with the requirements of the following standards:
- EN ISO 15607: Specification and qualification of welding procedures for metallic materials. General rules.
 - EN ISO 9606: Qualification testing of welders. Fusion welding.
 - EN 1264-4:2021: Water based surface embedded heating and cooling systems. Installation.
 - BSRIA Guide Pre-commission Cleaning of Pipework Systems (Latest Edition).
 - BS 5422:2023: Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C.
 - EN 12266: Industrial valves. Testing of metallic valves.
 - EN 12516: Industrial valves. Strength of valve shells.
 - EN 1092: Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated.
 - TR/6: (Latest Edition). Site pressure testing of pipework. Building Engineering Services Association. Guide to good practice.

- EN 13480: Metallic industrial piping.
- EN 12828: Heating systems in buildings. Design of water-based heating systems.
- EN 1434: Heat meters.
- EN1 60529: Degrees of protection provided by enclosures (IP code).

12.3 Equipment

12.3.1 Pipework

- 12.3.1.1 All heating pipework up to Ø150mm shall be fabricated from medium quality mild steel tubing to BS EN 10255 with fittings to BS EN 10242, all heating pipework equal to or greater than Ø150mm shall be fabricated from carbon steel tubing to BS EN 10216 with fittings to BS EN 10253.
- 12.3.1.2 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.
- 12.3.1.3 All pipework shall be installed using threaded or welded joints according to size. No compression fittings shall be used.
- 12.3.1.4 Pipework up to and including 50 mm nominal bore shall be threaded.
- 12.3.1.5 Pipework over 50 mm nominal bore shall be welded throughout.
- 12.3.1.6 Particular care shall be taken to protect equipment and surrounding finishes during all jointing and welding operations.
- 12.3.1.7 All pipework shall be painted with 2No. Coats of red oxide by the Contractor prior to insulation and cladding.
- 12.3.1.8 Electrodes, filler wires and rods should be stored and handled in accordance with the manufacturer's instructions. 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.
- 12.3.1.9 All welding shall be Class 2 welding carried out by Oxy-Acetylene Welding to BS 2460:1982 and current amendments or by Arc welding to BS 2971:1977 (replaced by BS 2971:1991) and current amendments.
- 12.3.1.10 The contractor shall ensure all gaskets selected are suitable for the jointed materials, system temperature and service.
- 12.3.1.11 Under no circumstances (with the exception of the underfloor heating installation or below ground pre-insulated pipework) shall Pex-Al-Pex pipework be used in this installation without prior written permission by the Consulting Engineer.
- 12.3.1.12 Pipework shall be protected against stock rust. Any pipe work beyond normal stock rust will not be accepted by the engineer. Any pipework deemed to have unacceptable levels of rust shall have the rust completely removed and shall be fully cleaned and repainted prior to handover
- 12.3.1.13 Direct buried below ground heating pipework shall comprise twin steel service pipes encased within polyurethane foam c/w alarm wire. The complete insulated twin pipe shall be encased within an aluminium oxygen diffusion barrier protected by an outer sheath of HDPE (high density polyethylene).
- 12.3.1.14 The District Heating / Direct buried below ground heating pipework insulation shall be guaranteed to achieve maximum: $\lambda=0.024\text{W/m.K}$.
- 12.3.1.15 The complete District Heating / Direct buried below ground heating pipework shall be rated for a life expectancy of 30 years at 140°C and 25bar operating pressure.

- 12.3.1.16 The District Heating / Direct buried below ground heating system shall be provided with a leak detection system to continuously monitor the district heating network and raise an alarm to the BMS via a volt free contact in the event of a leak.
- 12.3.1.17 The contractor shall develop the District Heating / Direct buried below ground heating pipework site layout with a specialist district heating pipework supplier to ensure the pipework installation is installed to allow for thermal expansion in accordance with EN 13941.
- 12.3.1.18 The Contractor shall not bend tubing around corners. The Contractor shall ensure that proper fittings are used to create any bends required. Piping shall be measured and cut to dimensions established at site and shall be worked into place without forcing. Pipe size changes shall be made with appropriate reducing fittings.
- 12.3.1.19 Any line taken off a branch line, with the exception of vents, drains and other instrument connections is considered a branch line. Branch connections shall be made with the use of tees or reducing outlet tees, compatible with the pipe joint systems throughout the pipework installation, Isolation to be allowed for at all Branch connections.
- 12.3.1.20 Where HVAC pipe work systems require diversion / modification / Tie-in the Contractor will engage a competent commissioning engineer to measure and record the following:
- System Type
 - Pipe dimensions
 - Water Mass Flow rate
 - Pressure drops
 - Water Velocity
- 12.3.1.21 The above information must be recorded along with the service type, service location, the area the service in question serves, all alternative options considered, and a scope of works for the execution. This shall be carried out on a standard form generated by the Contractor and be submitted to the Engineers for Review.
- 12.3.2 Pipework Insulation
- 12.3.2.1 All heating pipework, valves, flanges, and fittings shall be insulated to prevent heat loss and ensure personnel protection. All insulation materials and installation practices shall comply strictly with BS 5422:2023 (Enhanced) and Building Regulations Approved Document L.
- 12.3.2.2 All concealed heating pipework shall be insulated with preformed rigid stone wool or glass fibre sections. Sections shall be supplied with a factory-applied reinforced aluminium foil facing (low emissivity ≤ 0.05) incorporating a self-adhesive overlap.
- 12.3.2.3 The mineral wool insulation shall be non-combustible to Euro Class A2, s1, d0 RtF according to EN 13501-1. All pipework insulation shall comply with the current Building Regulations Part B. The Contractor shall provide calculations and documentation demonstrating that the installed pipework insulation achieves a thermal conductivity value, as determined by BS 5422:2023 for the specific application. The aluminium foil covering shall achieve a maximum vapor permeance, as determined by BS 5422:2023 for the specific application.

- 12.3.2.4 Pipework insulation shall be pre-formed sections of stone wool insulation, manufactured pre-slit for ease of application and have a layer of factory-applied foil facing and a self-adhesive 1 lap. Backing tape used to completely seal the joint.
- 12.3.2.5 The Contractor shall provide documentation demonstrating that the thermal conductivity achieves the values required by BS 5422:2023 for the specific application (typically ≤ 0.034 W/m.K at 40°C mean).
- 12.3.2.6 Insulation shall be applied to clean, dry pipework. Sections shall be applied with the longitudinal joint at the "3 or 9 o'clock" position. Joints shall be sealed by peeling the protective tape from the self-adhesive lap and pressing firmly. Where adjacent sections abut, they shall be sealed with 75mm wide matching reinforced aluminium foil tape to maintain the integrity of the vapor barrier.
- 12.3.2.7 The Contractor shall provide insulated Pipe Support Inserts. Pipe supports shall be manufactured from high-density phenolic insulation. Each support shall be supplied with a factory-applied aluminium foil vapor barrier. All pipe support inserts shall comply with EN 14314.
- 12.3.2.8 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.
- 12.3.2.9 To prevent thermal bridging and maintain vapor barrier continuity, insulated inserts shall be installed at every support point:
- High-density, CFC/HCFC-free phenolic insulation (80kg/m³) or non-combustible load-bearing mineral material, rated for the system temperature.
 - Inserts must be factory-fitted with a reinforced aluminium foil jacket.
 - The joint between the pipe insulation and the support insert shall be bridged and sealed with 75mm wide aluminium foil tape.
 - Inserts shall comply with EN 14314
- 12.3.2.10 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.
- Internal/Plant: Not less than 0.8mm thick aluminium sheeting or stucco embossed profile cladding.
 - External: All external insulation shall be weatherproofed with a PIB (polyisobutylene) primary layer or specialized metal cladding, ensuring all joints are arranged to shed water.
- 12.3.2.11 All valves within plantrooms and throughout the building shall be insulated using 'valve jackets' 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 centers to prevent the insulation from shafting or pulling away from the outer jacket. All covers to be of a 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 EN 13501-1 for fire classification.

- 12.3.2.12 All valve insulation jackets shall have the following characteristics:
- Fabric type – Pyrogel XT or equivalent, compliant with BS 5422:2023 for the application.
 - Fabric thickness: 10 mm
 - Max operating temperature: As required by the system design, and compliant with BS 5422:2023.
 - Thermal conductivity value - k = As required by the system design, and compliant with BS 5422:2023.
 - Resistance to heat flow - R = As required by the system design, and compliant with BS 5422:2023.
 - Density: As required by the system design, and compliant with BS 5422:2023.
 - Resistant to water, steam, and other leaks
 - Resistant to pressure and impact
 - Fire rating: Compliant with EN 13501-1.
 - Roper Material: ceramic fabric, Temperature Resistance: 1260 °C.
 - Jacket type: Inner layer - fiberglass fabric, temperature resistance: 500°C, Outer coat - cyclone fabric, temperature resistance: 200°C, Including hook-and-loop fasteners and metal wire hooks.
 - Jackets shall be of sewn construction using fiberglass or silicone-coated fabric. For high-performance applications, Pyrogel XT or equivalent may be used.
 - Jackets shall be secured with hook-and-loop fasteners or stainless steel wire hooks. Flaps must be installed to provide water shedding.
 - All jackets shall comply with EN 13501-1 for fire classification and be tagged with a unique identification reference.
- 12.3.2.13 Technical Data Submissions, the Contractor shall provide material data sheets for all products, including:
- Declared Thermal Conductivity at the relevant mean temperature.
 - Fire Classification (Euroclass).
 - Vapor Permeance of foil facings.
 - Calculations proving compliance with BS 5422:2023 heat loss limits for the specified pipe diameters.
- 12.3.2.14 The Contractor shall provide material data sheets for all insulation products, including thermal conductivity, fire rating, and vapor permeance, to demonstrate compliance with BS 5422:2023 and the other specified standard
- 12.3.2.15 Minimum Thickness Requirements Heating pipework insulation thicknesses shall conform to the table below. These thicknesses are based on a low emissivity outer surface ($\epsilon = 0.05$) and a thermal conductivity of 0.034 W/m.K. If materials with higher emissivity or higher thermal conductivity are used, thicknesses must be increased in accordance with BS 5422:2023.

Insulation Thickness – Low emissivity outer surface ($\epsilon = 0.05$)

Nominal pipe bore	LTHW Heating Systems
(mm)	(mm)
15	40
20	40
25	40
32	50
40	50
50	50
65	50
80	60
100	70
125	70
150	70
200	70
250	70
Above 250	70
Flat Surfaces	70

12.3.3 Fittings

- 12.3.3.1 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.
- 12.3.3.2 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.
- 12.3.3.3 All unions shall be of the best quality gunmetal, cone seated type.
- 12.3.3.4 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.

12.3.4 Valves

- 12.3.4.1 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.

12.3.5 Isolating Valves

- 12.3.5.1 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.
- 12.3.5.2 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.
- 12.3.5.3 Isolation valves shall be supplied with Extended Stem, to allow pipe insulation to pass over the valve body.

12.3.6 Double Regulating Valves

- 12.3.6.1 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.
- 12.3.6.2 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.
- 12.3.6.3 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.
- 12.3.6.4 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.

12.3.7 Check Valves

- 12.3.7.1 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.
- 12.3.7.2 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.

12.3.8 Differential pressure Control Valves (DPCV)

- 12.3.8.1 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.

- 12.3.8.2 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.
- 12.3.8.3 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.
- 12.3.8.4 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 or -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.
- 12.3.8.5 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.
- 12.3.9 Pressure Independent 2-port Control Valves (PICV)
- 12.3.9.1 The contractor shall make contact with valve manufacturer to review PICV 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.
- 12.3.9.2 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:-
- 12.3.9.3 2 Port Control with actuator (please refer to control strategy for particular actuator specification).
- 12.3.9.4 Automatic (lockable) flow regulator with external, visible flow indicator markings for hydronic balancing.
- 12.3.9.5 Internal differential pressure control arrangement to maintain flow control and valve authority.

- 12.3.9.6 Pressure measurement test points (including necessary adaptor / transition pieces).
- 12.3.9.7 Pressure Independent Control Valves (PICVs) shall be provided as complete kits, encompassing all necessary components from a single manufacturer. This kit must include a fixed orifice measuring station for verifying commissioned flow rates, a fly pass for isolation, flushing, draining, and bleeding, an insulation valve shell, and a strainer positioned upstream of the PICV. Installation of all PICVs and kit components shall be strictly in accordance with the manufacturer's guidelines.
- 12.3.9.8 Contractor shall be responsible for final sizing of all motorised valves, control valves, regulating valves and pressure regulators. The contractor shall review valve position and piping arrangement with specialist valve supplier, prior to placing valves on order and / or proceeding with pipework installation.
- 12.3.9.9 All motorised valves shall be supplied by the specialist Controls Contractor for free-issue installation by the Contractor (Unless otherwise stated or unless motorised valves are integral to Dynamic control valve system). Where motorised valves are provided with a smaller diameter connection size than the pipework serving the valve, all pipework and associated valves and fittings either side of the motorised valve shall be installed to the specified pipeline diameter, with local reduction only immediately before and after the motorised valve flanges.
- 12.3.9.10 All PICV and DPCV shall be provided as free issue by the BMS Controls Contractor (unless otherwise specified) and installed by the Mechanical Contractor. The BMS Controls Contractor, as the specialist, shall be responsible for sizing all heating control valves in coordination with the proposed valve manufacturer. The valve manufacturer shall review all design drawings and map out the system and provide recommendations for any proposed changes to ensure precise system commissioning in conjunction with the mechanical contractor's commissioning specialists. Full control valve schedule shall be issued for the engineer's review.
- 12.3.10 Pressure Independent Thermostatic Radiator Valves (PITRV)
- 12.3.10.1 All Pressure independent thermostatic radiator valves shall be suitable for a working temperature of 2°C to 110°C. All thermostatic radiator valves shall be suitable for a maximum working pressure 10Bar.
- 12.3.10.2 All Pressure independent thermostatic radiator valves shall come with tamperproof TRV guard.
- 12.3.10.3 All thermostatic radiator valves shall be pressure independent self-balancing radiator valves supplied complete with an in-built double regulating facility. The TRV insert shall provide an adjustable function, limit / control the water flow through the emitter at full load. The commissioning function (or KV function) shall have six separate graduations / settings to assist in the commissioning of the heating system, the TRV shall be capable of automatic hydronic balancing, the volume flow is kept constant even if the differential pressure in the system fluctuates.
- 12.3.10.4 All Pressure independent thermostatic radiator valves shall be brass valve with nickel plated body, stem made of stainless steel. For threaded and compression connection. Tested and approved according to EN 215.
- 12.3.10.5 All thermostatic radiator valves are to be supplied complete with a liquid filled direct acting (unless otherwise stated) thermostatic sensing head. The head is to have a temperature range between 7-28°C and have limiting and locking facilities. Each sensing head shall have positive isolation.

- 12.3.10.6 All TRVs shall have the facility to change or replace the internal working mechanism without the need to drain the heating system. This is to be carried out using a specialist service tool.
- 12.3.11 Thermostatic Radiator Valves (TRV)
- 12.3.11.1 Thermostatic radiator valves shall be proportional regulators that function without auxiliary energy. They shall regulate room temperature by varying the volume flow of the heating water. The valves must comply with the requirements of the German Energy Saving Directive (EnEV) and be certified to EN 215.
- 12.3.11.2 The valve body shall be constructed from nickel-plated brass or bronze. The valve stem shall be stainless steel and feature a double stem seal. It must be possible to replace the complete valve insert without draining the system by using a dedicated tool.
- 12.3.11.3 Standard valves shall be rated for a maximum operating pressure of 10 bar. The operating temperature range shall be from 2°C to 120°C, with tolerance for short periods up to 130°C. The maximum differential pressure against which the valve can close shall be 1 bar, with a recommended control range of 30 to 200 mbar.
- 12.3.11.4 Where specified, high-pressure variant valves shall be provided. These valves shall be rated for a maximum operating pressure of 16 bar and a maximum differential pressure of 3 bar. The operating temperature range shall be 2°C to 120°C, with tolerance for short periods up to 140°C.
- 12.3.11.5 Valves shall be suitable for use with water or ethylene/propylene glycol-water mixtures, with a maximum glycol proportion of 50%. The fluid pH value must be between 6.5 and 8
- 12.3.11.6 Valves shall be equipped with an infinitely adjustable presetting mechanism to adapt the volume flow to the required heat demand. The protective cap supplied with the valve must not be used for permanent closure; a dedicated metal cap must be fitted to the valve outlet for this purpose, e.g., when a radiator is removed.

12.4 Construction Products Regulations

- 12.4.1 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.
- 12.4.2 All products where applicable must comply with relevant Harmonised European Standards (hENs)
- 12.4.3 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.
- 12.4.4 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.
- 12.4.5 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.
- 12.4.6 Ancillary Certificates of Compliance are required from "Specialist" contractors i.e. Heat Pump Specialist.
- 12.4.7 These ancillary certificates must comply with the suite of certificates developed by RIAI, ACEI, Engineers Ireland and SCSi specifically:
- Ancillary Certificate Compliance: Design (Completion)
 - Ancillary Certificate Compliance on Completion
- 12.4.8 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.
- 12.4.9 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.

- 12.4.10 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.

12.5 Samples & Technical Submittals

- 12.5.1 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.
- 12.5.2 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.
- 12.5.3 The contractor shall be responsible for determining quantities from IN2 Engineering Design Partnership drawings and specifications.
- 12.5.4 The contractor shall liaise with the various specialist suppliers to ensure that all necessary fixings kits, supports, connections, etc. are included.
- 12.5.5 The contractor shall refer to IN2 Engineering Mechanical Specification, Section M00 General specification.
- 12.5.6 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.

12.6 Approved Manufacturers and Vendors

- 12.6.1 The following manufacturers may be considered for the provision of the heating pipework fittings and instrumentation.
- Safety valves, Prescor S, manufactured by Flamco as supplied by Eurofluid Handling Systems or Equivalent.
 - Isolating valves, manufactured by Crane as supplied by BSS or Equivalent.
 - Double regulating valves, manufactured by Crane as supplied by BSS, or Equivalent.
 - Fixed orifice double regulating valves, manufactured by Crane as supplied by BSS, or Equivalent.
 - Check valves, manufactured by Crane as supplied by BSS or Equivalent.
 - Strainers, manufactured by Crane as supplied by BSS or Equivalent.
 - Temperature Gauges, manufactured by Boss as supplied by BSS, or Equivalent.
 - Pressure Gauges, manufactured by Boss as supplied by BSS, or Equivalent.
 - Pressure Independent Control Valves, manufactured by Oventrop or Giacomini or Equivalent.
 - Differential pressure Control Valves (DPCV), manufactured by Oventrop or Equivalent.
- 12.6.2 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.

12.7 Installation

12.7.1 The arrangement and size of all heating pipework and fittings as required shall be as shown as indicated on IN2 Engineering Design Partnership M10 series drawings and where necessary, as agreed with the Engineers on site.

12.7.2 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.

12.7.3 Pipework

12.7.3.1 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

- 12.7.3.2 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.
- 12.7.3.3 All supports for steel pipes and fittings shall be ferrous.
- 12.7.3.4 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.
- 12.7.3.5 Brackets or supports shall be set out so that they do not obstruct the access to valves, flanges or other fittings requiring maintenance.
- 12.7.3.6 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.
- 12.7.3.7 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.
- 12.7.3.8 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. The inside diameter of the sleeves shall not be less than 15 mm larger than the outside diameter of the pipe, except where pipes pass through bearing walls or footings where sleeves shall be 100 mm larger than the outside diameter of the pipe. The diameter of the sleeve shall be such that adequate clearance between the pipe and the sleeve will allow insulation to be carried out through the sleeves. Sleeves shall protrude not less than 1 mm and not more than 3 mm proud of the finished surface.
- 12.7.3.9 Pipework expansion loops, guides & anchors to be provided where necessary. Anchor & expansion points indicated on IN2 drawings are for information / guidance only. Contractor to forward detailed proposal for system expansion loops to engineer for approval.
- 12.7.3.10 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.
- 12.7.3.11 Anchors shall be fitted as appropriate to suit expansion points. They shall generally be fabricated from 100mm x 50mm channel iron. Saddles, fabricated from flattened 28mm diameter pipe, shall be bolted to the channels.
- 12.7.3.12 Expansion bellows shall only be considered where space is constricted (to be agreed in writing with Engineer prior to installation / ordering). Access to be provided for future maintenance
- 12.7.3.13 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.

- 12.7.3.14 Were the contractor intending to run pipework exposed or surface mounted, the contractor submit proposal for design team approval.
- 12.7.3.15 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.
- 12.7.3.16 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.
- 12.7.4 Fittings
- 12.7.4.1 All fittings and instrumentation shall be installed so that they are accessible for inspection, lubrication and maintenance and are fully operable.
- 12.7.4.2 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.
- 12.7.4.3 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.
- 12.7.4.4 Temperature and pressure gauges shall be installed in a visible and accessible position.
- 12.7.4.5 Temperature and pressure gauges shall be installed in self-draining stainless-steel pockets.
- 12.7.4.6 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.
- 12.7.4.7 All flow meters to be provided free from BMS controls contractor (Unless otherwise stated) and installed by mechanical contractor. 12.7.6Valves
- 12.7.4.8 Safety valves shall be fitted to all heat pumps, buffer vessels, 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 drainpipe with a visible discharge point, positioned where injury to persons cannot occur.
- 12.7.4.9 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.
- 12.7.4.10 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.
- 12.7.4.11 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.

- 12.7.4.12 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.
- 12.7.4.13 Drain valves shall be installed at all low undrainable parts of the system.
- 12.7.4.14 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.
- 12.7.5 Insulation
 - 12.7.5.1 Pipework shall remain un-insulated until satisfactory completion of all hydraulic tests.
 - 12.7.5.2 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.
 - 12.7.5.3 Heating pipework within all plantrooms and external areas shall be cladded for protection of insulation.
 - 12.7.5.4 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.
 - 12.7.5.5 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.

12.8 Testing & Commissioning

- 12.8.1 The Mechanical Contractor shall be responsible for the complete testing, flushing, and commissioning of all heating systems, including all associated pipework, plant, and equipment, in accordance with the latest editions of BSRIA and CIBSE guidelines, and as specified herein.
- 12.8.2 All testing and commissioning activities shall be carried out by suitably qualified and experienced commissioning engineers. The Contractor shall provide evidence of their qualifications and experience to the Consulting Engineer for approval.
- 12.8.3 The Contractor shall prepare a detailed Commissioning Plan, including a schedule of all tests, procedures, and documentation, for approval by the Consulting Engineer at least four weeks prior to the commencement of any testing activities.
- 12.8.4 All testing equipment shall be calibrated and certified, with valid calibration certificates provided to the Consulting Engineer.
- 12.8.5 All tests shall be witnessed by the Consulting Engineer or their representative, and test results shall be recorded in approved test sheets.
- 12.8.6 The Contractor shall rectify any defects or deficiencies identified during testing and commissioning at their own expense.
- 12.8.7 The Contractor shall provide a comprehensive demonstration and training session for the Client's personnel on the operation and maintenance of the heating systems.
- 12.8.8 Pipework Pressure Testing:
- All pipework systems shall be hydrostatically tested in accordance with TR/6 (Latest Edition).
 - Test pressure shall be 1.5 times the design working pressure, or as specified in the relevant standards.
 - Test duration shall be a minimum of 4 hours, with no visible leaks or pressure drops.
 - Test procedures and results shall be documented on approved test sheets.
- 12.8.9 Flushing and Chemical Cleaning:
- All pipework systems shall be thoroughly flushed and chemically cleaned in accordance with BSRIA Guide Pre-commission Cleaning of Pipework Systems (Latest Edition).
 - The Contractor shall provide a detailed flushing and cleaning procedure, including the type and concentration of chemicals used.
 - Water samples shall be taken before, during, and after flushing to verify cleanliness.
 - The Contractor shall provide a chemical dosing log recording all chemicals added to the system.
- 12.8.10 Air Source Heat Pump (ASHP) System Testing:
- The ASHP system shall be tested in accordance with the manufacturer's recommendations and relevant standards.
 - Performance tests shall include heating capacity, efficiency, and noise levels.
 - All controls and BMS interfaces shall be tested and verified.

12.8.11 Heat Meter Testing:

- Heat meters shall be tested and calibrated in accordance with EN 1434.
- Accuracy of flow and temperature measurements shall be verified.
- M-Bus communication with the BMS shall be tested and verified.

12.8.12 Valve Testing:

- All valves shall be tested for correct operation and leakage in accordance with EN 12266.
- Motorised control valves shall be tested for correct response to BMS signals.
- Differential pressure control valves shall be tested to ensure they maintain the set pressure differential.

12.8.13 System Balancing:

- The complete heating system shall be hydraulically balanced to achieve design flow rates and temperatures.
- Balancing valves shall be adjusted and locked in position.
- Balancing reports shall be provided, including flow rates, pressure drops, and temperature measurements.

12.8.14 Electrical Testing:

- All electrical connections and wiring shall be tested for continuity, insulation resistance, and earth resistance.
- All electrical equipment shall be tested for correct operation and safety.
- Testing shall comply with relevant electrical standards and regulations.

12.8.15 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.

12.8.16 Seasonal Commissioning and Handover

12.8.17 The specialist contractor shall carry out seasonal commissioning to verify system performance under varying load conditions. This will involve return visits to site during the first 12 months of operation to check and fine-tune system controls and performance during both heating and cooling seasons. A comprehensive commissioning report, including all test records, calibration certificates, and performance data, shall be submitted as part of the building logbook for final handover.

12.9 Labelling

- 12.9.1 Pipework Identification: All pipework shall be clearly identified using self-adhesive coloured bands at intervals not exceeding 3 meters. Bands shall be placed at valve or expansion joint locations, duct or building inlet and exit points, and on either side of wall or floor penetrations. Identification shall adhere to BS 1710: 2014, with colours conforming to BS 4800: 2011.
- 12.9.2 The service name shall be indicated on a worded identification band located in a visible position, along with an arrow showing the direction of flow. Flow and return mains shall be identified with the letter's "F" or "R," respectively, appended to the service name.
- 12.9.3 Suppliers shall be requested to label all equipment and packages with identification numbers, to ensure items can be correctly identified.
- 12.9.4 All equipment, valves, and fittings shall be individually numbered and identified using durable "traffo labels" securely affixed. A protected valve chart with a permanent finish, detailing the positions and numbering of all valves, shall be installed in an agreed-upon location.
- 12.9.5 All pipe hangers, supports and anchor brackets, etc. which do not have a galvanised or other protective coating, shall be painted with one coat of paint.
- 12.9.6 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.
- 12.9.7 Suppliers shall be requested to label all equipment and packages with identification numbers, to ensure items can be correctly identified.
- 12.9.8 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.

12.10 Documentation

- 12.10.1 The Mechanical Contractor shall provide comprehensive documentation for all heating systems, including design drawings, installation records, test reports, and operating and maintenance manuals.
- 12.10.2 All documentation shall be provided in both hard copy and electronic format (PDF) and shall be organized in a clear and logical manner.
- 12.10.3 All documentation shall be submitted to the Consulting Engineer for approval prior to handover.
- 12.10.4 As-Built Drawings:
- As-built drawings shall accurately reflect the installed heating systems, including all pipework, plant, and equipment.
 - Drawings shall be marked up with all modifications and deviations from the design drawings.
 - Drawings shall be provided in AutoCAD and PDF formats.
- 12.10.5 Installation Records:
- Installation records shall document the installation of all pipework, plant, and equipment, including materials used, installation methods, and any issues encountered.
 - Records shall include photographs of the installed systems.
- 12.10.6 Test Reports:
- Test reports shall document all testing and commissioning activities, including test procedures, results, and any defects or deficiencies identified.
 - Reports shall include calibration certificates for all testing equipment.
- 12.10.7 Operating and Maintenance Manuals:
- Operating and maintenance manuals shall provide detailed instructions on the operation, maintenance, and troubleshooting of the heating systems.
 - Manuals shall include manufacturer's data sheets, maintenance schedules, and spare parts lists.
- 12.10.8 Commissioning Reports:
- A comprehensive commissioning report shall be provided, summarizing all testing and commissioning activities and verifying that the heating systems meet the design requirements.

12.10.9 Heat Meter Calibration Certificates:

- All heat meter calibration certificates shall be provided, documenting the accuracy of the meters.

12.10.10 Valve Sizing and Selection Reports:

- Reports detailing the sizing and selection of all control valves, including manufacturer's data and calculations.

12.11 Extra Materials

12.11.1 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.

- 1No. Room Temperature sensors
- 1No. Pressure Independent Control Valves (PICV) replacement body assemblies

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20.1 Outline Description

- 20.1.1 The Contractor shall refer to IN2 Engineering Design Partnership Electrical & BMS specifications and drawings, to ensure all equipment is compatible. The Contractor shall bring any 'inconsistencies' to the design's attention during the tendering process.
- 20.1.2 The Contractor shall be responsible for the supply and installation, of all ventilation systems as detailed as indicated on IN2 Engineering Design Partnership drawings.
- 20.1.3 The Ventilation Installations shall provide complete systems for the following areas, including the supply and installation of all necessary ventilation ductwork, diffusers, grilles, volume control dampers, fire smoke damper & associated panel, external louvres, roof cowl, and access panels for ductwork cleaning and future maintenance access:
- Supply and Extract fans in the Seclusion room
 - Supply and Extract fans in the Anti room
- 20.1.4 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) 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.
- 20.1.5 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.
- 20.1.6 The 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 13779:2016+A1:2020	EN	Ventilation for non-residential buildings - Performance requirements for ventilation and room-conditioning systems
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+A1:2011		Fans for general purposes. Specifications for balancing and vibration

BS EN IEC 60879:2019	Comfort fans and regulators for household and similar purposes. Methods for measuring performance
(EU) No 1253/2014	Implementing Directive 2009/125/EC of the European Parliament and of the Council regarding eco-design requirements for ventilation units
EN 16798	Energy performance of buildings - Ventilation for buildings
EN ISO 16890	Air filters for general ventilation
EN 12102	Air conditioners, liquid chilling packages, heat pumps and dehumidifiers with electrically driven compressors for space heating and cooling - Measurement of airborne noise - Determination of sound power level
EN 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN ISO 5801:2017	Industrial fans - Performance testing using standardized airways
EN 12101-3	Smoke and heat control systems - Part 3: Specification for powered smoke and heat exhaust ventilators
EN 60335-2-80	Household and similar electrical appliances - Safety - Part 2-80: Particular requirements for fans
EN 1751:1998	Ventilation for buildings - Air terminal devices - Aerodynamic testing of dampers and valves
HVCA TR/19	Guide to Good Practice - Cleanliness of Ventilation Systems (UK)
EN 15780:2011	Ventilation for buildings - Ductwork - Cleanliness of ventilation systems
EN 60335-2-89	Household and similar electrical appliances - Safety - Part 2-89: Particular requirements for commercial refrigerating appliances with an incorporated or remote refrigerant condensing unit or compressor
ISO 15330	Acoustics — Measurement of airborne noise emitted by stationary road vehicles — Survey method
IEC 60364	Electrical installations for buildings
Eurovent Certification	Certification of performance rating for Air Handling Units, Fans, and other HVAC equipment. Ensures compliance with declared performance.
BS EN 1886:2025	AHU Mechanical Performance. (Newest classifications for casing strength and leakage).
20.2.2	All ventilation plant shall comply with the maximum Specific Fan Power requirements as per TGD Part L 2022 (Table 6). Note that these are the maximum allowable limits; the actual equipment selection should aim for better performance to meet the building's Energy Performance Coefficient (EPC).

Table 4 Maximum specific fan power in air distribution systems

System type	SFP
-------------	-----

	(W/(l/s))
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 ^{1,2})	0.5
Kitchen extract, fan remote from zone with grease filter	1.0

The rating weighted average is calculated by the following formula:

$$\frac{P_{\text{mains}1} \times \text{SFP1} + P_{\text{mains}2} \times \text{SFP2} + P_{\text{mains}3} \times \text{SFP3}}{P_{\text{mains}1} + P_{\text{mains}2} + P_{\text{mains}3}}$$

Where P_{mains} is useful power supplied from the mains.

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.

Table 5 Extending specific fan power for additional components

Component	SFP (W/(l/s))
Additional return filter for heat recovery	+0.1
HEPA Filter ¹	+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 Plate heat exchangers (both cross flow and counter flow) shall have a bypass damper.
- 20.2.5 The contractor shall ensure that all relevant standards are adhered in specification and installation of all extract fans.
- 20.2.6 Heat Recovery & Energy Efficiency
- 20.2.7 In accordance with the Ecodesign Directive (ErP) and Part L 2022:
- 20.2.8 Run-Around-Coil Systems: Minimum thermal efficiency shall be 68%.
- 20.2.9 Thermal wheels, plate exchangers Minimum thermal efficiency shall be 73%.
- 20.2.10 Bypass Dampers: All plate heat exchangers (cross-flow and counter-flow) must include a thermal bypass for summer cooling and frost protection.
- 20.2.11 All fans (shall be fitted with variable speed drives EC motors to facilitate demand-controlled ventilation.
- 20.2.12 Filtration & Cleanliness
- 20.2.13 Installation must comply with I.S. EN 15780 (Cleanliness of ventilation systems).
- 20.2.14 Sufficient access panels must be provided for cleaning and motor maintenance as per I.S. EN 12097 & BESA TR19
- 20.2.15 Filters must be selected according to I.S. EN ISO 16890. Supply air filters should typically meet ePM1 50% (equivalent to F7) for urban environments.

20.3 Equipment

20.3.1 Supply and Extract Fans

20.3.1.1 All extract & supply fan units shall be Plate Mounted Axial Flow Fans



- 20.3.1.2 Fans shall be selected to allow an increase in duty to **120%** of design air volume at **120%** of design external static pressure.
- 20.3.1.3 Single Fans shall be of high efficiency backward-curved mixed-flow fan, manufactured in galvanised steel, unless otherwise stated. Fans shall be direct drive with high efficiency motors and shall be fitted with an integral inverter variable speed drive to provide stepless speed control.
- 20.3.1.4 Fans shall have High efficiency EC motors comply with the efficiency level IE5 for operating temperatures up to +60°C EC.
- 20.3.1.5 Fans shall have a fitted IP55 terminal box allows the fan to be positioned conveniently to incoming electrical inputs. Fan
- 20.3.1.6 Fan shall be specially treated against corrosion, powder coated with polyester epoxy paint.
- 20.3.1.7 All fans (inc those contained within packaged plant items i.e., AHU's, FCU's, HRU's etc) 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.
- 20.3.1.8 All fans, & HRU's shall have a specific fan power complaint with the TGD Part L 2022, at rated duty.
- 20.3.1.9 All extract Fans assemblies shall incorporate airflow fail monitors.
- 20.3.1.10 All extract fans shall come complete with a minimum 5 years warranty.
- 20.3.1.11 All extract & supply 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.

- 20.3.1.12 All extract & supply 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/m³. The attenuator 'sound absorbing material' shall be chemically inert, non-combustible, non-hygroscopic and vermin resistant. The attenuator shall be tested in accordance with ASTM E 477. The attenuator shall be suitable for internal and external use at any installed angle.
- 20.3.1.13 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 M70 BMS General Descriptions of Operation, for description of required controls system operation.
- 20.3.1.14 Fans shall be Hybrid silencer/casing manufactured from EPP and special composite material, is fully airtight class C according to EN12237.
- 20.3.1.15 Fans shall be complete with EC motors have an integrated electronic thermal protection including locked-rotor protection and soft-start.
- 20.3.1.16 EC motors shall be complete with built-in potentiometer to adjust working point can be also controlled by external signal 0-10V.
- 20.3.1.17 All extract shall be supplied with local controllers, PIR, trickle and boost control, with 15-min run on timer, BMS interface (Enable / Fault), back draught damper, and silencers.

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.
- 20.4.2 All products where applicable must comply with relevant Harmonised European Standards (hENs)
- 20.4.3 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.
- 20.4.4 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.
- 20.4.5 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.
- 20.4.6 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.
- 20.4.7 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.
- 20.4.8 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.
- 20.5.6 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 Supply and Extract Fans.
- Elta fan or 'Systemair' or Equivalent.
- 20.6.2 All equipment and ancillary components must be selected from the same manufacturers range.
- 20.6.3 All final electrical connections (where applicable) to be made by supplier at expense of 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 Installation

- 20.7.1 All installation work shall adhere strictly to the approved IN2 Engineering Design Partnership drawings, specifications, relevant British Standards (BS), European Norms (EN), and local building regulations, including manufacturer's instructions.
- 20.7.2 All final electrical connections, where applicable, shall be completed by the equipment supplier at the contractor's expense, each connection certified as a Sub-System with a separate Sub-System Completion Certificate. These certificates, along with relevant Test Record Sheets, must be submitted to the Project Supervisor for inclusion in the Project Safety Manual, with detailed records of Sub-System Completion Certificate numbers and descriptions.
- 20.7.3 All electrical work must comply with the current edition of the National Rules for Electrical Installations. Adequate access for future maintenance, inspection, and servicing of all installed equipment must be provided, ensuring clear access pathways and sufficient clearance. Coordination with other trades is essential for seamless integration, and all equipment must be protected from damage during installation and subsequent construction activities. Installation shall minimize noise and vibration transmission, with appropriate anti-vibration measures implemented where necessary.
- 20.7.4 The contractor shall coordinate all equipment support requirements with the main contractor to ensure proper structural integration and load distribution.
- 20.7.5 Supply and Extract Fans
- 20.7.6 Supply and Extract fans are to be installed as per the drawings, with accessibility for maintenance, coordinated electrical wiring, integration of controls for operation, necessary ductwork connections, weatherproofing for external fans, and backdraft or motorized dampers where needed.
- 20.7.7 Attenuators
- 20.7.8 Attenuators shall be installed as indicated on the drawings, with necessary ductwork connections, and must be selected from the same manufacturer's range as the associated equipment.
- 20.7.9 Roof plant installation shall include proper support, weatherproofing, and vibration isolation, with all roof penetrations properly sealed.
- 20.7.10 All AHU's, MVHRs, and extract fans shall be installed so as to be readily accessible for future maintenance.
- 20.7.11 Contractor shall liaise with Electrical contractor to coordinate wiring of AHU's.
- 20.7.12 The 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 Contractor shall be responsible for the complete installation, testing, balancing, and commissioning of the ventilation systems. This shall be carried out by competent installers and commissioning specialists, with appropriate qualifications (e.g., QQI, ETB, or equivalent).
- 20.8.2 Commissioning Plan: The Contractor shall develop and submit a detailed commissioning plan to the Engineer for approval prior to the commencement of any commissioning activities. The plan shall outline the commissioning procedures, testing methods, and acceptance criteria for all ventilation systems and components.
- 20.8.3 The Contractor shall provide evidence of the competency and qualifications of all personnel involved in the testing and commissioning process.
- 20.8.4 The Contractor shall include for the 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). The independent validation process shall be agreed upon with the Engineer.
- 20.8.5 Air Leakage Testing: Air leakage tests for all ductwork systems shall be conducted in accordance with DW/144:2016, "Specification for Sheet Metal Ductwork." Testing shall be performed by a competent person and witnessed by the design engineer or their representative.
- 20.8.6 Testing shall be completed prior to the application of thermal insulation and cladding, and before the installation of ceiling systems, or any other building element that could prevent access to ductwork.
- 20.8.7 Leakage Rate and Audible Leakage: In addition to meeting the leakage rate requirements of DW/144:2016, the complete ductwork installation shall be free of audible leaks. Any audible leaks detected shall be rectified by the contractor at their own expense and retested.
- 20.8.8 The contractor shall provide a detailed test report, including test pressures, leakage rates, locations of leaks, and any remedial actions taken.
- 20.8.9 The testing equipment used shall be calibrated, and valid calibration certificates shall be provided.
- 20.8.10 Airflow measurements and balancing shall be performed by a qualified commissioning specialist in accordance with CIBSE Commissioning Code A: Air Distribution, or equivalent recognized standards.
- 20.8.11 Airflow rates shall be measured at all supply, return, and extract air terminals, and adjusted to match the design values. Measurements shall also be taken at AHU inlets and outlets, and at other key points in the system as indicated on the drawings or required by the Engineer.
- 20.8.12 Commissioning Report: The commissioning specialist shall provide a detailed commissioning report, including:
- Airflow measurements at all locations.
 - Balancing adjustments made.
 - System performance data (e.g., fan speeds, motor currents).
 - Details of any issues encountered and how they were resolved.
 - A signed certificate of completion.
- 20.8.13 The complete ventilation system, including air handling plant and extract fans, shall be tested under normal operating conditions to verify that it meets the design requirements for:

- Airflow rates and distribution.
 - Temperature control.
 - Pressure differentials.
 - Filtration effectiveness.
- 20.8.14 Noise and Vibration: Noise levels shall be measured and verified to comply with the project's noise criteria. Vibration levels shall also be checked and recorded.
- 20.8.15 Control System Testing: All control systems, including automatic controls, interlocks, and safety devices, shall be tested and verified to operate correctly in all modes of operation. This includes testing of:
- Start-up and shut-down sequences.
 - Modulation of airflow.
 - Response to temperature changes.
 - Operation of alarms and safety features.
- 20.8.16 Documentation: The results of all system performance testing shall be documented in a comprehensive report, including:
- Test procedures and methods.
 - Test results compared to design criteria.
 - Details of any deviations or deficiencies.
 - Corrective actions taken.
- 20.8.17 Final Commissioning
- 20.8.18 The Contractor shall demonstrate the operation of all ventilation systems to the client and the Engineer.
- 20.8.19 The Contractor shall provide training to the client's personnel on the operation and maintenance of the ventilation systems.
- 20.8.20 Upon successful completion of all testing and commissioning activities, the Contractor shall provide all commissioning documentation to the Engineer and the client.
- 20.8.21 The specialist commissioning contractor shall carry out seasonal commissioning to verify system performance under varying load conditions. This will involve return visits to site during the first 12 months of operation to check and fine-tune system controls and performance during both heating and cooling seasons. A comprehensive commissioning report, including all test records, calibration certificates, and performance data, shall be submitted as part of the building logbook for final handover.

20.9 Labelling

- 20.9.1 All ventilation system components, including but not limited to ductwork, equipment, dampers, access panels, valves, terminals, and electrical components, shall be clearly and permanently labelled for identification, operation, maintenance, and control.
- 20.9.2 Labelling shall be durable, legible, and resistant to environmental conditions, including temperature extremes, humidity, condensation, vibration, dust, and cleaning agents. Labels shall be designed to remain legible throughout the expected lifespan of the system. The identification shall be in accordance with BS 1710: 2014 with colours to BS 4800: 2011.
- 20.9.3 Labels shall be securely attached using appropriate methods, The attachment method shall not damage the component being labelled. Such as:
- High-performance adhesive labels (for smooth, clean surfaces).
 - Engraved or stamped tags (for harsh environments or where greater durability is required).
 - Stainless steel cable ties (for pipes, ducts, and cables).
 - Mechanical fixings (screws or rivets) where appropriate and permissible.
- 20.9.4 All labelling shall align with the provided schematic drawings, plantroom layout diagrams, and control schematics. Consistent labelling conventions shall be maintained throughout the system.
- 20.9.5 All ventilation equipment, including air handling units (AHUs), fans, and control panels, shall be labelled with their identification number, manufacturer, model number, and electrical supply details.
- 20.9.6 Nameplates for fans and air handling units shall include, but not be limited to:
- Unit reference
 - Manufacturer details
 - Model reference
 - Electrical data
 - Design airflow rate and pressure
 - Commissioned airflow rate and pressure
- 20.9.7 Labels for all equipment shall be Traffolyte labels or equivalent, engraved with the required information.
- 20.9.8 Labels shall be placed in visible locations on the equipment and on associated control panels.
- 20.9.9 Plantrooms shall have clear schematic diagrams displayed, that include the labelling of equipment.

20.10 Documentation

- 20.10.1 Comprehensive O&M manuals shall be provided in both electronic (PDF) and hard copy formats.
- 20.10.2 The O&M manuals shall include, but not be limited to:
- Manufacturer's product data sheets for all equipment (AHUs, fans, filters, dampers, etc.).
 - Detailed operating instructions for all systems and equipment.
 - Preventative maintenance schedules and procedures.
 - Troubleshooting guides.
 - Wiring diagrams and control schematics.
 - Parts lists and supplier information.
 - Safety procedures.
- 20.10.3 O&M manuals shall be indexed and organised for easy reference.
- 20.10.4 Test Results: All test results shall be documented and provided in a clear and organised format. Test results shall include, but not be limited to:
- Date of test.
 - Duration of test.
 - Test procedures used.
 - Equipment used for testing.
 - Environmental conditions during testing (temperature, humidity, etc.).
 - Detailed test measurements and readings.
 - Acceptance criteria and results (pass/fail).
 - Signatures of the contractor's witness and the Engineer's representative witness.
- 20.10.5 Commissioning Results: Commissioning results shall be documented and provided in a clear and organised format. Commissioning results shall include, but not be limited to:
- Date of commissioning for each system and component.
 - Design airflow rates and pressure drops.
 - Commissioned airflow rates and pressure drops.
 - Air balancing reports, including individual airflow rates for each air terminal device.
 - Fan performance curves (design vs. actual).
 - Noise and vibration measurements.
 - Control system testing and verification.
 - Functional performance testing of all systems.
 - As-built drawings showing the final installation of all ventilation plant and systems, including ductwork layouts, equipment locations, and control device locations.
 - A comprehensive air terminal schedule.

- Air tightness test results.
- Building Management System (BMS) integration test results.
- A commissioning checklist.
- Commissioned flowrates and pressure drops.

20.11 Extra Materials

- 20.11.1 At practical completion the contractor shall replace all filters in installed ventilation systems with new filters. This includes, but is not limited to, air handling units (AHUs), local heat recovery units, fan coil units, indoor air conditioning units and any dedicated extract systems.
- 20.11.2 At practical completion, the following spare parts and items shall be provided to the client for their future use:
- A complete set of replacement filters for all installed ventilation systems, including air handling units, fan coil units, dedicated extract systems, and any other filtered ventilation equipment.

20.12 Appendix A: Schedule of Supply and Extract Fans

20.12.1 Contractor shall refer to the M20 Layouts, Schematics and associated Schedules

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20.1 Outline Description

- 20.1.1 The Contractor shall be responsible for the supply and installation, of all ventilation supply and extract devices as detailed as indicated on IN2 Engineering Design Partnership drawings.
- Appendix A: Schedule of Extract Air Devices
 - Appendix B: Schedule of Supply Air Devices
 - Appendix C: Schedule of External Louvres
- 20.1.2 The Contractor shall be responsible for the Design, Selection and installation of the complete support & Bracketry systems (inc Anti-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.
- 20.1.3 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.
- 20.1.4 The Contractor shall carefully read the notes on the drawings and include for all associated costs in his tender.

20.2 Standards

20.2.1 All air terminal devices shall be installed in accordance with the following standard.

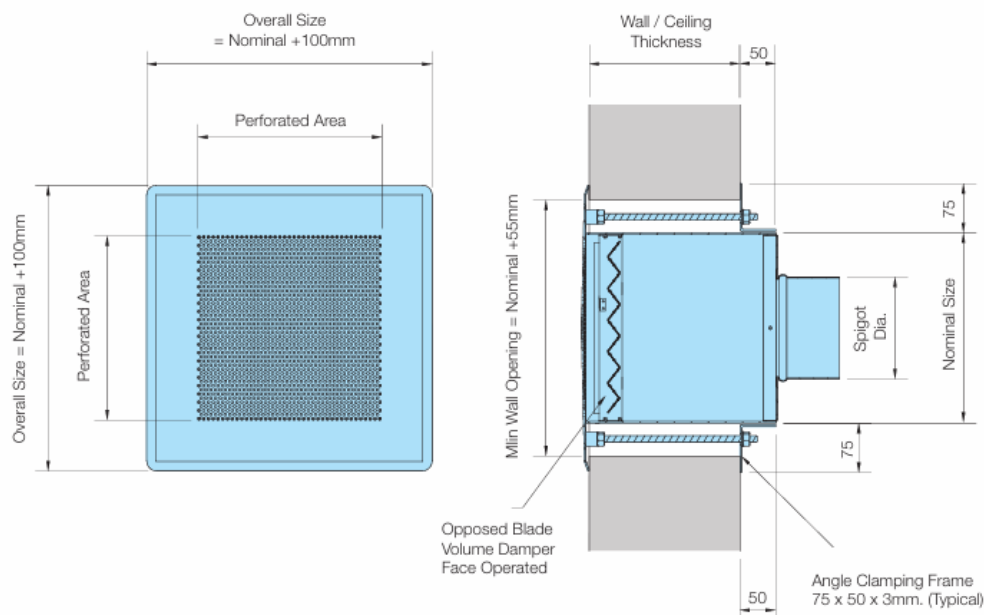
BS EN 13141 Parts 1 to 11	Ventilation for buildings. Performance testing of components/products for residential ventilation
BS EN 15780:2011	Ventilation for buildings. Ductwork. Cleanliness of ventilation systems
BS EN 16798	Energy performance of buildings. Ventilation for buildings
HEVAC	Guide to Air Distribution Technology
BS EN 12238:2001	Ventilation for buildings - Air terminal devices - Aerodynamic testing and rating for mixed flow applications
BS EN 1751:1998	Ventilation for buildings - Air terminal devices - Aerodynamic testing of dampers and valves
ISO 5219:1984	Air distribution and air diffusion - Laboratory aerodynamic testing and rating of air terminal devices

20.3 Equipment

20.3.1 All air terminal devices shall be selected and installed to achieve the following performance criteria, measured in accordance with BS EN 12238:2001:

- Noise breakout: Not exceeding 25 dB(A) at the specified design airflow rate. Noise levels shall be measured in accordance with ISO 5135 or equivalent.
- Pressure drops: Not exceeding 20 Pa at the specified design airflow rate.
- Airflow pattern: The air terminal devices shall provide the air flow patterns shown on the design drawings.
- Air tightness: Air terminal devices shall meet air tightness Class C of EN 1751.

20.3.2 Anti-Ligature grilles shall be designed for installation, creating a seamless, unbroken effect along the wall for the safety of the patients. The manufacturer shall provide installation details to ensure continuity. Diffusers shall be of the flangeless type with concealed fixings, finished in anodized aluminium. Each diffuser shall incorporate a volume control damper (VCD) on the plenum spigot for air balancing, accessible after installation. Diffuser shall also have



20.3.3 Anti-ligature grilles shall be IP3X safety rating, meaning holes must be 2mm in diameter at 4mm centres in a triangular pitch pattern



20.3.4 All supply diffusers and return grilles shall be supplied complete with integral opposed blade dampers, and associated plenum boxes.

- 20.3.5 The Contractor shall provide dedicated structural support for all plenum boxes. Plenum boxes must be independently supported from the building structure, entirely separate from the ductwork system and the ceiling grid. All supports shall be designed based on load calculations, and installation details must be submitted for the Engineer's approval. The installation must comply with the guidelines in DW/144: Specification for Sheet Metal Ductwork, or the latest edition.
- 20.3.6 All plenum boxes shall be factory-painted, both internally and externally, with a durable, non-reflective matt black finish prior to delivery to the site.
- 20.3.7 Each diffuser shall be supplied complete with all necessary installation accessories, including fixing springs, gaskets, protection rings, and any other components required for a secure and airtight installation.
- 20.3.8 The Contractor shall submit manufacturer's performance data, including airflow rates, pressure drops, noise ratings, and air tightness class, for all air terminal devices to the Engineer for approval prior to placing orders.
- 20.3.9 The Contractor shall include for all supply and extract air devices to be finished in a non-standard RAL colour, as specified by the Architect. The contractor is responsible for ensuring the finish is durable and matches the approved sample.
- 20.3.10 Air terminal devices shall be installed in accordance with the manufacturer's instructions and best industry practices.
- 20.3.11 The contractor is responsible for the air balancing of the air terminal devices. The air balancing must be completed to the required air flow rates, as shown on the design drawings.
- 20.3.12 Contractor shall engage a qualified commissioning specialist at the early stages of the project to determine the required number and placement of Volume Control Dampers (VCDs) for effective air balancing.
- 20.3.13 The Contractor shall be responsible for ensuring the correct number of VCDs are installed to allow for proper commissioning. The VCDs must be installed with sufficient straight duct lengths both upstream and downstream, as recommended by the VCD manufacturer and industry best practices, to ensure accurate airflow measurement and adjustment.
- 20.3.14 The Contractor is responsible for ensuring the entire air terminal device system is designed and installed to be fully commissionable.
- 20.3.15 The commissioning specialist, under the Contractor's supervision, is responsible for the air balancing of the air terminal devices. The air balancing must be completed to the required air flow rates, as shown on the design drawings.
- 20.3.16 The contractor shall provide samples of each air terminal device, in the specified finish, for approval by the architect prior to ordering."
- 20.3.17 The manufacturer/supplier of the supply diffusers and return grilles shall provide Computational Fluid Dynamics (CFD) analysis reports as part of their technical submittal. These reports shall demonstrate the airflow patterns within each space and confirm that the air terminal devices will provide comfortable conditions in both heating and cooling modes. The CFD analysis shall be submitted for review by the Engineer prior to ordering.
- 20.3.18 The Following parameters shall be used for the CFD analysis.
- 20.3.19 Cooling Mode:
- 18 Degrees Import to room

- 24 Degrees Ambient of Room
- 20.3.20 Heating Mode:
- 24 Degrees Import to room
 - 18 Degrees Ambient of Room
- 20.3.20.1 Contractor to confirm flow rates, pressure drops and noise ratings of all grilles prior to placing order.
- 20.3.20.2 Contractor shall include for a non-standard RAL colour to Diffusers and Grilles, as applied by the manufacturer.
- 20.3.20.3 Mechanical contractor to confirm flow rates, pressure drops and noise ratings of all grilles prior to placing order.
- 20.3.20.4 Mechanical contractor to confirm **throws & terminal velocities**, aswell as flow rates, pressure drops and noise ratings of all grilles prior to placing order.

- 20.3.21 All supply diffusers and extract grilles shall come complete with Opposed Blade Dampers for commissioning purposes.
- 20.3.22 All supply diffusers and extract grilles face shall be finished to non-standard finish. Finishes shall be subject to architectural approval.
- 20.3.23 Contractor to confirm **throws & terminal velocities**, Aswell as flow rates, pressure drops, noise ratings and provide a **3d simulation** all diffusers and grilles in each space prior to placing order.
- 20.3.24 External Louvres
- 20.3.24.1 External weather louvres shall be complete with integrated non-return dampers, designed to provide effective protection against the ingress of rainwater, debris (leaves), and avian intrusion through outdoor air and exhaust air openings. The integrated non-return damper shall prevent reverse airflow, ensuring unidirectional air movement. The assembly shall be supplied as a factory-assembled, ready-to-install unit.
- 20.3.24.2 The assembly shall comprise:
- A robust front border.
 - Aerofoil rain defence blades designed for low differential pressure.
 - A rear-mounted crimped wire mesh grille for debris and pest exclusion.
 - An integrated non-return damper with casing, low friction bearing blades, travel stops, and sealing components.
- 20.3.24.3 Blade Configuration: External louvre blades shall be positioned at a 45-degree angle to the horizontal, with both edges turned to effectively exclude rainwater. Blade spacing shall be designed to prevent horizontal visibility.
- 20.3.24.4 Bird Screen: A 15 mm square mesh, galvanised after manufacture, wire bird screen shall be installed on the inside of the louvre, with provision for easy access for cleaning.
- 20.3.24.5 Blanking: Any sections of the louvre assembly not utilised for air intake or discharge shall be completely blanked off with galvanized sheet steel. The blanking shall be adequately stiffened to prevent drumming.
- 20.3.24.6 Performance Requirements:
- Rain Penetration: The weather louvre shall be tested and classified according to EN 13030, demonstrating its effectiveness in minimising rain penetration.

The manufacturer shall provide test reports verifying compliance with the required classification.

- Nominal Sizes: 200 × 180 mm to 1600 × 1665 mm. Intermediate sizes within this range shall be available.
- Operating Temperature: -20°C to +80°C.
- Maximum Differential Pressure (Closing Direction): 100 Pa.
- Air Leakage: The louvre and damper assembly shall be designed to minimize air leakage.
- Acoustic Performance: The assembly shall be designed to minimise air-regenerated noise (LWA) as specified in the project drawings or schedules.
- Pressure Drop: The pressure drop at specified airflow rates shall be as indicated on the drawings or schedules.
- Non-Return Damper Operation: The non-return damper shall be designed for passive operation, opened and closed by airflow without requiring an actuator.
- Free Area: All weather louvres shall be manufactured with a minimum free area of 50%, Max. Face Velocity of 2.0m/s. Area of the louvres shall be subject to the Engineer's approval.

- 20.3.24.7 Louvres shall be factory-assembled combination of weather louvre and non-return damper.
- 20.3.24.8 Louvres shall be based on Aerofoil blade design for low differential pressure.
- 20.3.24.9 Installation subframes shall be provided for simplified and efficient installation.
- 20.3.24.10 The rear grille shall be available in the following configurations:
- Galvanised steel crimped wire mesh.
 - Galvanised steel crimped wire mesh with insect screen.
- 20.3.24.11 Technical data, including airflow rates, differential pressure and air-regenerated noise shall be provided by with the contractor's technical submittal from the proposed manufacturer.
- 20.3.24.12 The manufacturer shall supply sizing data to confirm the selected louvre and damper combination is suitable for the design airflow rates.
- 20.3.24.13 Provide the EN13030 test report showing the rain penetration class of the louvre.
- 20.3.24.14 Duct Slope: At all duct connections to louvres, the bottom of the duct shall slope downwards towards the opening to prevent water ingress.
- 20.3.24.15 All weather louvres shall be manufactured with a minimum free area of 50%.
- 20.3.24.16 Installation shall be executed in strict accordance with the manufacturer's instructions to ensure a permanent, weather-tight seal and facilitate a simple mounting process.

20.4 Approved Manufacturers and Vendors

- 20.4.1 The following manufacturers may be considered for the provision of the Grilles/Diffusers and all components.
- Security Ventilation Grilles, supplied by Swegon or Equivalent.
- 20.4.2 The following manufacturers may be considered for the provision of the external louvres and motorised louvres.
- Fieger, supplied by crossflow or Equivalent.
- 20.4.3 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.

20.5 Installation

- 20.5.1 All air terminal devices shall be installed as indicated on IN2 Engineering Design Partnership M20 series drawings.
- 20.5.2 All final electrical connections (where applicable) to be made by supplier at expense of 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.
- 20.5.3 The Contractor shall allow for all necessary ductwork transformation and flexible connections for the complete installation of the supply and extract valves and grilles.
- 20.5.4 The contractor shall produce reflected ceiling as part of coordination process. The contractor shall submit reflected ceiling plan from approval by design team prior to commencing work.

20.6 Testing & Commissioning

- 20.6.1 Commissioning data shall include for measured air flow rates to each individual air device.
- 20.6.2 All diffusers and grilles shall be supplied with internal commissioning dampers to facilitate air balancing.
- 20.6.3 Where units are installed in restricted locations, such as within permanent plasterboard ceilings, the Mechanical Contractor shall ensure that all internal dampers are accessible through the face of the air device for adjustment.
- 20.6.4 In instances where internal adjustment is not feasible, the Mechanical Contractor and Main Contractor shall coordinate the exact location and size of access hatches. These hatches must be positioned to ensure full access is available for initial commissioning, as well as any future maintenance and re-balancing requirements.

20.7 Labelling

- 20.7.1 Each air terminal device (supply diffuser, return grille, linear grille, etc.) shall be discreetly marked with a unique identification number or code on the plenum box or an internal, non-visible surface.
- 20.7.2 The identification number/code shall correspond to the designations shown on the design drawings and within the air balancing report.
- 20.7.3 The location of each concealed identification marking shall be accurately recorded on the "As-Built Ventilation Air Terminal Schedule".
- 20.7.4 The service provided by each air terminal device (e.g., "Supply Air," "Return Air," "Extract Air") shall be indicated on the "As-Built Ventilation Air Terminal Schedule."
- 20.7.5 The direction of airflow shall be indicated on the "As-Built Ventilation Air Terminal Schedule."
- 20.7.6 As-Built Ventilation Air Terminal Schedule:
- A durable, wall-mounted "As-Built Ventilation Air Terminal Schedule" shall be provided in a designated location (e.g., plant room, maintenance office).
 - The schedule shall include the following information for each air terminal device:
 - Unique identification number/code (corresponding to concealed markings).
 - Location within the building (e.g., room name, grid reference).
 - Service provided (supply, return, extract).
 - Design airflow rate (m^3/s or l/s).
 - Commissioned airflow rate (m^3/s or l/s).
 - Date of commissioning.
 - Initials of the commissioning technician.

20.8 Documentation

- 20.8.1 Upon project completion, the contractor shall provide comprehensive Operation and Maintenance (O&M) manuals and detailed as-built documentation for all installed ventilation systems, including air terminal devices. These documents shall be provided in both electronic (PDF) and hard copy formats.
- 20.8.2 The O&M manuals shall include, but not be limited to, the following information related to air terminal devices:
- Manufacturer's product data sheets and installation instructions for each type of air terminal device.
 - Detailed maintenance procedures, including cleaning schedules and recommended replacement parts.
 - Troubleshooting guides for common issues.
 - Information on adjusting or re-balancing air terminal devices.
 - Details on the location and operation of any integral volume control dampers (VCDs).
- 20.8.3 The as-built documentation shall include:
- Detailed as-built drawings showing the location and type of each air terminal device.
 - An "As-Built Ventilation Air Terminal Schedule including:
 - Unique identification number/code for each device.
 - Location within the building (e.g., room name, grid reference).
 - Service provided (supply, return, extract).
 - Design airflow rate (m^3/s or l/s).
 - Commissioned airflow rate (m^3/s or l/s).
 - Date of commissioning.
 - Initials of the commissioning technician.
 - CFD analysis reports as provided by the manufacturer/supplier, demonstrating airflow patterns and comfort conditions.
- 20.8.4 Upon completion of the project, the contractor shall provide detailed commissioning results for all air terminal devices, including:
- Date of commissioning.
 - Design airflow rates and pressure drops for each air terminal device.
 - Commissioned airflow rates and pressure drops for each air terminal device.
 - Individual airflow rates for each air terminal device.
- 20.8.5 Full spectrum noise data in selected areas, as requested by the Engineer, including:
- Date of test.
 - Design noise rating (dB(A)).
 - Commissioned noise rating (dB(A)).
 - Test methods used.

- Location of test.
- Air tightness test results.
- Air balancing reports.

20.8.6 The contractor shall provide all technical submittals, including manufacturer's performance data, airflow rates, pressure drops, noise ratings, air tightness class, and CFD analysis, for all air terminal devices prior to placing orders."

20.9 Appendix A: Schedule of Extract Air Devices

20.9.1 Contractor shall refer to M20 Layout Drawings, Schematics and IN2 Schedules.

20.10 Appendix B: Schedule of Supply Air Devices

20.10.1 Contractor shall refer to M20 Layout Drawings, Schematics and IN2 Schedules.

20.11 Appendix C: Schedule of External Louvres

20.11.1 Contractor shall refer to M20 Layout Drawings, Schematics and IN2 Schedules.

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22.1 Outline Description

- 22.1.1 The Contractor shall be responsible for the supply and installation, of all ventilation systems as detailed as indicated on IN2 Engineering Design Partnership drawings.
- 22.1.2 The Ventilation Installations shall provide complete systems for the following areas, including the supply and installation of all necessary ventilation ductwork, diffusers, grilles, volume control dampers, external louvres, and access panels for ductwork cleaning:
- Supply and Extract Fans for the Seclusion room
 - Supply and Extract Fans for the Anti room
- 22.1.3 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) 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.
- 22.1.4 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.
- 22.1.5 The 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 installations shall comply with the requirements of the following standards:

EN 16798-3:2017	Energy performance of buildings - Ventilation for buildings - Part 3: For non-residential buildings - Performance requirements for ventilation and room-conditioning systems
BS 5422: 2023	Thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range –40 °C to +700 °C. Method for specifying.
DW/144:2016:	Specification for sheet metal ductwork, low, medium and high pressure/velocity systems.
BS EN 1366-3:2021+A1:2024	Penetration seals Fire resistance tests for service installations
EN1366: Part 1	Fire Resistance Tests for Services Installations. Ventilation 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
HVCA TR/19	Guide to Good Practice - Cleanliness of Ventilation Systems.
EN 15780:	Ventilation for buildings - Ductwork - Cleanliness of ventilation systems.
CIBSE Guide B:	Heating, Ventilating, Air Conditioning, and Refrigeration. (Provides general guidance on ventilation, including ductwork cleaning and kitchen ventilation. Check the latest edition.)
Irish Building Regulations	Local Irish Building Regulations and relevant codes of practice related to ventilation and fire safety.

22.3 Equipment

22.3.1 Ductwork

22.3.1.1 Ductwork shall be fabricated from hot-dip galvanized sheet steel conforming to HVCA DW/144, "Specification for Sheet Metal Ductwork." The gauge and construction shall be as specified within DW/144 for the relevant pressure class of the system.

22.3.1.2 The arrangement and size of all ductwork as required shall be as shown on IN2 Engineering Design Partnership drawings.

22.3.1.3 Ductwork bends shall, wherever practicable, be of equal radius design. Where mitred bends are unavoidable, aerodynamically designed turning vanes shall be installed to minimise pressure drop and ensure uniform airflow.

22.3.2 Ductwork - Flexible

22.3.2.1 Flexible ductwork shall be limited to final connections between diffusers/grilles and rigid ductwork. Flexible duct connections **shall not exceed 300mm in length**, to minimise pressure drop, and shall not be used for directional changes. Flexible ductwork shall be installed in a fully stretched manner, avoiding compression.

22.3.2.2 All flexible ductwork shall be 'semi-rigid' type, manufactured from aluminium, to allow for flexibility in both the axial and lateral planes.

22.3.2.3 Flexible ductwork shall be manufactured from a spirally wound corrugated strip with a double overlapped and crimped joint, ensuring pressure tightness up to 1000 Pa. The corrugated depth shall be designed to provide maximum flexibility while resisting physical damage. The internal surface shall be smooth to minimize friction losses. The maximum allowable leakage rate for flexible ductwork shall be 3% of design airflow.

22.3.2.4 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.

22.3.2.5 Flexible ductwork shall have an operating temperature range of -30°C to 180°C and a maximum air velocity of 30 m/s. If thermal insulation is required, it shall have an R-value of 6.0.

22.3.2.6 Flexible ductwork shall be classified according to EN 13501-1, achieving a minimum Euro class rating of B-s1, d0. Test reports confirming compliance with EN 13501-1 shall be provided.

22.3.2.7 Compliance with the smoke generation requirements of EN 13501-1, as evidenced by the specified Euro class rating, shall be deemed sufficient.

22.3.2.8 The contractor shall provide a detailed schedule outlining the locations where flexible ductwork will be used and the reasons for its selection, for approval by the design engineer.

22.3.2.9 Rigid ductwork shall be used wherever possible. Flexible ductwork shall only be utilised where it is absolutely necessary for the final connection to air terminal devices.

22.3.3 Ductwork - Insulation

- 22.3.3.1 All supply, extract, fresh, and exhaust 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 a self-adhesive overlap for a vapor-tight seal.
- 22.3.3.2 The glass fibre insulation shall be non-combustible, meeting Euroclass A1 or better in accordance with the Building Regulations Part B (Fire Safety). The reinforced aluminium foil facing shall also meet Euroclass A1 or better.
- 22.3.3.3 The reinforced aluminium foil facing shall achieve a maximum vapour permeance of 0.00024 g/s·m·N to effectively prevent moisture ingress. The insulation shall achieve a thermal conductivity of 0.035 W/m·K.
- 22.3.3.4 For supply air and return air ductwork, the insulation thickness shall be a minimum of 75mm to achieve a minimum thermal resistance (R-value) of 2.14 m²K/W.
- 22.3.3.5 Ductwork installed in external or unconditioned areas, exposed to the elements, or where condensation is a significant risk, shall be further protected with external cladding. The cladding material shall be Stucco Aluminium. The cladding shall be installed with appropriate weather seals and fixings to prevent water ingress.
- 22.3.3.6 All joints and penetrations in the insulation and cladding shall be sealed with compatible vapour-tight tape or sealant to maintain the integrity of the insulation system and prevent thermal bridging.

22.3.4 Exposed Ducting

- 22.3.4.1 All exposed un-insulated ventilation ductwork shall be powder-coated. The finish shall be applied off-site prior to installation.
- 22.3.4.2 The Contractor is to submit a colour chart to the Architect for final colour selection. For tendering purposes, the Contractor shall base their pricing on RAL 1034.

22.3.5 Volume Control Dampers

- 22.3.5.1 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.
- 22.3.5.2 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.
- 22.3.5.3 Damper blades shall be aerodynamic ribbed double skin type Ferritic Stainless Steel 50mm wide x 0.4mm thick blades. Housed within a galvanised mild steel flanged or galvanised spigotted casing being suitable for systems with a temperature range of – 20 °C through to +70 °C.
- 22.3.5.4 The blade drive mechanism shall be totally enclosed, precise movement, opposed blade cap and bar drive mechanism positioned out of the airstream for protection against damage
- 22.3.5.5 The VCD casing shall be 1.5mm thick galvanised mild steel casing having peripheral flanges with pre-punched elongated corner holes to suit proprietary duct flanges.
- 22.3.5.6 The VCD Manual Control shall consists of a knob and slimline control box with blade position locking facility and visual blade position indication.



22.3.6 Ductwork – Access Hatch

22.3.6.1 All access hatches shall be constructed from galvanized sheet steel, stainless steel, or other corrosion-resistant materials suitable for the intended environment.

22.3.6.2 Access hatches shall be of double-skinned construction with a minimum thickness of 25mm, or as specified in the design drawings.



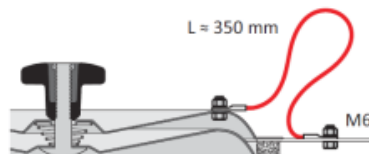
22.3.6.3 Access hatches for rectangular and circular ducts shall be press-formed with inner and outer cover plates, secured by corrosion-resistant bolts and knobs.

22.3.6.4 Access hatches shall incorporate a self-adhesive, closed-cell gasket (e.g., polyethylene, neoprene) on the inner cover plate to ensure airtightness at the specified operating pressures.

22.3.6.5 The insulation contained between the door panels shall be non-combustible and have a minimum thermal density of 45 kg/m³. For commercial kitchen extract systems insulation must be suitable for high temperature applications.

22.3.6.6 Access hatch airtightness shall meet or exceed Class D according to EN 1507/ATC2 (EN 16798-3 TUV NORD Certificate), when installed on a smooth, clean surface and sufficiently tightened ($F \geq 500\text{N}$).

22.3.6.7 All access hatches shall be supplied with a retaining cable kit to prevent accidental dropping of the door during maintenance.



22.3.6.8 The frame shall incorporate a compression gasket seal to maintain airtightness.

22.3.6.9 Access hatches shall be installed in accordance with DW/144:2016, BS EN 15780, and TR/19, "Internal Cleanliness of Ventilation Systems," to facilitate cleaning and inspection.

22.3.6.10 Access hatches shall be positioned to provide unobstructed access for cleaning, inspection, and maintenance.

22.3.6.11 Access hatches must be independently supported.

22.3.6.12 The contractor shall prepare and submit access hatch layout drawings, demonstrating the size and coordinated location of all hatches, for approval by the design engineer.

22.3.6.13 Ductwork shall edges shall be burr free and rubber gasket shall be fitted to ductwork to prevent injury. All access hatches shall have rubber gaskets fitted to ductwork edges.

- 22.3.6.14 The contractor shall install access hatches in the ductwork systems according to the locations specified in the design drawings and in compliance with TR/19 and BS EN 15780.
- Volume Control Dampers – Both Sides
 - Fire / Smoke Dampers - Both Sides
 - Attenuators – Both Sides
 - Changes in Direction – Both Sides
 - Filter Sections – Both Sides
 - Horizontal Ducts – Generally 3m centres
 - Risers – Maximum 3m centres
 - Extract Fans – Both Sides
 - Discharge grille / mesh – One Side
- 22.3.7 Fire / Smoke Actuated Dampers (FSD)
- 22.3.7.1 Fire/smoke actuated dampers shall be motorised units designed for seamless integration with the addressable fire alarm system, providing individual monitoring and control capabilities. Construction shall adhere to stringent standards, featuring galvanised steel casings, fire-resistant insulating blades, galvanized steel shafts and push rods, brass bearings, and polyurethane/elastomer seals.
- 22.3.7.2 Leakage and Thermal Protection: Dampers must ensure compliance with EN 1751 Class 2 for closed blade leakage and Class C for casing leakage. Each damper must incorporate a 72°C thermal fuse.
- 22.3.7.3 Regulatory Compliance and Certification: Dampers must be CE marked and fully comply with EN 1366-2, EN 15650, and all relevant Irish building regulations.
- 22.3.7.4 Actuators shall provide proportional torque control, dual failsafe electro-thermal fusible links, and manual test switches, with clear status feedback to the addressable panel.
- 22.3.7.5 Each damper shall be fitted with an appropriate expansion/installation frame, either HEVAC type or stud wall type, including cleats as required for secure installation.
- 22.3.7.6 Installation must be completed following manufacturer's instructions.
- 22.3.7.7 Dampers shall be supported independently of the ductwork using purpose-designed supports. The damper's integral lugs are to be used for alignment guidance only and shall not be relied upon for structural support.
- 22.3.7.8 Dampers to be LPCB approved (Loss Prevention Certification Board) meaning 3rd party regular re-assessment/audit testing to ensure quality of product & service are maintained.
- 22.3.7.9 Provide documentation to demonstrate compliance with EN 1366-2, and EN 15650.
- 22.3.7.10 Provide documentation showing the materials used in the damper construction.
- 22.3.7.11 Prior to the commencement of full installation, the contractor shall construct a benchmark installation of a representative fire/smoke damper assembly, including breakaway connections, independent supports, and fire stopping.

22.3.8 Smoke/Fire Damper Control & Addressable Monitoring System

- 22.3.8.1 The contractor shall engage a specialist company to supply, test, commission, and certify a fully addressable smoke/fire damper control and monitoring system. The system, including all dampers, must be provided and commissioned by a single entity with demonstrable experience in similar projects, providing ongoing Irish-based technical support, commissioning, and maintenance. The specialist shall possess valid Professional Indemnity Insurance for BCAR final sign-off and provide evidence thereof.
- 22.3.8.2 The system shall feature an open protocol, modular, computerized platform for continuous monitoring and control of all smoke/fire dampers. Each damper's status (open, closed, travelling, fault) shall be graphically displayed on a digital interface, with manual override via touchscreen. The system must support automated scheduled damper testing, remote access, and integration with BMS via BACnet or Modbus. The panel PC shall utilize solid-state technology for enhanced reliability, with capacity for extensive I/O and network expansion.
- 22.3.8.3 Smoke Fire Damper Interface (SFDI) Devices: A Smoke Fire Damper Interface device shall be mounted at each damper in the field and connected to the panel via network cable. Damper open/closed and identifying "wink" LED patterns shall be standard on each local SFDI. These field SFDI devices allow for full addressability and individual control of all dampers. Damper interfaces shall accommodate local heat/smoke detectors, operate at various voltages, provide local status indication, and be housed in IP54 enclosures.
- 22.3.8.4 Network cabling shall adhere strictly to the manufacturer's specifications to ensure stable and reliable system operation.
- 22.3.8.5 All fire alarm cabling interfaces shall be "Enhanced PH120" fire resistance cable. The contractor shall provide documentation confirming the cable's compliance with relevant fire safety standards.

- 22.3.8.6 The system shall possess the following core functionalities:
- Detailed logging of all system activity for diagnostics and maintenance.
 - Phased commissioning and future expansion capabilities.
 - Ethernet/IP compliance.
 - Flexibility for last-minute adjustments to strategies, zones, and damper configurations.
 - Robust Boolean logic for complex I/O cause-and-effect scenarios.
 - Full system configuration and diagnostics available from the Panel PC.
 - Graphical User Interface (GUI) displaying real-time damper status, location, and cause-and-effect strategy displays.
 - CE marking, LVD, and EMC compliance.
 - Adaptability to diverse building requirements.
 - Monitoring options including individual or group/zone configurations, with multiple wiring topologies supported.
 - Open protocol interoperability.
 - Conventional fireman's override panels.
 - Email and text notification capabilities.
 - Remote access and network panel control.
 - Flexible software for standardized operation.
 - BMS integration via RS-232, Modbus, or BACnet over IP for data exchange.
 - Capability to cater to both smoke/fire and environmental occupancy strategies.
 - Alarm priorities.
 - Up to 512 off I/O per panel and up to 64 off networks per panel.
- 22.3.8.7 A full report of "as installed" devices and cause-and-effect programming shall be provided, including customisable text fields for I/O device descriptions.
- 22.3.8.8 Automatic scheduled damper testing initiated by user, an input or a scheduled task, including omit option for critical dampers. Separate test log provided.

22.4 Approved Manufacturers and Vendors

- 22.4.1 The following manufacturers may be considered for the provision of the ductwork and all components.
- Lindab Safe Air Duct System or Equivalent.
- 22.4.2 The following manufacturers may be considered for the provision of the fire smoke dampers and all components.
- Safegard Systems, or Equivalent.
- 22.4.3 The following manufacturers may be considered for the provision of the volume control dampers and all components.
- Lindab, or Equivalent.
- 22.4.4 The following manufacturers may be considered for the provision of the Dust extract system and all components.
- Harold Engineering or Equivalent.
- 22.4.5 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.

22.5 Installation

- 22.5.1 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.
- 22.5.2 All final electrical connections (where applicable) to be made by supplier at expense of 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.
- 22.5.3 Ductwork
- 22.5.4 All ductwork systems shall be installed by approved contractors regularly engaged in similar work and compliant with DW/144:2016. The Contractor shall submit the Ductwork Sub-Contractor's details for approval prior to commencement of work on site.
- 22.5.5 All fire-rated and fire/smoke-rated ductwork shall be installed by a specialist contractor holding current third-party certification from an INAB-accredited scheme, or equivalent, and in accordance with ASFP TGD 18 and relevant BS EN 1366 standards.
- 22.5.6 All open ends of ductwork shall be sealed with durable caps or plugs during construction to prevent the ingress of construction debris.
- 22.5.7 Brackets and supports shall be installed to provide adequate clearance for access to dampers, access panels, and other fittings requiring maintenance, adhering to BS EN 12236:2002.
- 22.5.8 Ductwork – Flexible
- 22.5.9 Flexible ductwork shall be cut to the required length in its fully extended state.
- 22.5.10 All joints in medium and high-pressure flexible ductwork applications shall be sealed using proprietary sealing systems recommended by the manufacturer. Only manufacturer-approved ancillaries, supports, and sealing systems shall be used.
- 22.5.11 Flexible ductwork shall be installed with a minimum bending radius of 1/2 of its diameter. Bends with radii smaller than this are not acceptable.
- 22.5.12 Flexible ductwork shall be supported at intervals recommended by the manufacturer to prevent sagging and maintain proper airflow.
- 22.5.13 Flexible ductwork shall maintain its minimum cross-sectional area in all conditions, whether bent, extended, or compressed.

22.5.14 Ductwork – Insulation

22.5.15 Insulation shall be installed in accordance with the manufacturer's instructions. Insulation shall be cut to fit, with top and bottom pieces overlapping the sides, and bonded to the ductwork using an approved adhesive applied in bands 100mm wide at 300mm centers. All joints shall be sealed with 100mm wide approved self-adhesive tape.

22.5.16 All bends, tees, and branches shall be insulated to the same specifications as the main ductwork. Mitred sections, transition pieces, and tee pieces shall be cut and fitted on site to suit the duct shape.

22.5.17 All ductwork insulation shall comply with the fire safety standards outlined in EN 13501-1 and shall achieve a rating of at least B-s1, d0.

22.5.18 Volume Control Dampers

22.5.19 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.

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

22.5.21 To ensure accurate commissioning readings and optimal performance, volume control dampers shall be installed with specific attention to detail. Dampers must be situated within straight duct runs, maintaining a minimum of three duct diameters upstream and one and a half duct diameters downstream to guarantee uniform airflow.

22.5.22 Airtight seals are essential to prevent air leakage, and all joints and connections should be meticulously sealed using appropriate sealant or tape.

22.5.23 The damper blades must operate smoothly, without any binding throughout their full range of motion. Adequate accessibility for commissioning engineers is required for taking readings and making adjustments; access panels or doors shall be provided by the contractor where necessary.

22.5.24 The locking mechanism of each damper must be rigorously tested to confirm its ability to hold the blades rigidly in the desired position. Finally, the accuracy of the visual blade position indicators shall be verified against the actual blade position.

22.5.25 Early engagement with a qualified commissioning specialist is mandatory. The contractor shall engage such a specialist at the commencement of ductwork installation. This specialist will conduct regular site reviews during the installation of volume control dampers to verify compliance with design drawings and installation requirements.

22.5.26 The commissioning specialist shall witness the installation and initial testing of a representative sample of dampers to ensure proper operation and identify potential issues early in the construction process.

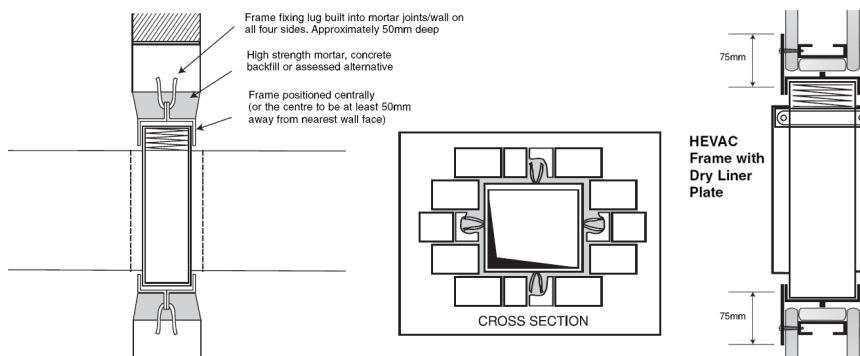
22.5.27 Written reports documenting the findings of each site review and any required corrective actions shall be provided to the engineers.

22.5.28 The commissioning specialist shall review the installation prior to ductwork insulation and ceiling closure.

22.5.29 The contractor must provide the commissioning specialist with all necessary access and information to facilitate the site reviews.

22.5.30 Furthermore, the contractor shall provide a leakage test of the installed dampers, for the engineer and commissioning specialist review.

- 22.5.31 As part of the overall commissioning process, all dampers shall be tested and balanced to achieve the design airflow rates.
- 22.5.32 Fire Dampers & Fire / Smoke Actuated Dampers (FSD)
- 22.5.33 All fire dampers and fire/smoke dampers shall be installed in accordance with BS 9999, BS EN 15650, BS EN 1366-2, and any relevant local building regulations, including Technical Guidance Document B (Fire Safety).
- 22.5.34 Access panels shall be provided for all fire dampers and fire/smoke dampers to facilitate inspection, testing, and maintenance. Access panels shall be easily removable or hinged and sealed to maintain the integrity of the fire compartment.
- 22.5.35 The contractor shall submit coordinated fire damper and fire/smoke damper drawings, aligned with the fire certificate drawings, to the design engineer and architect for review and approval at least four weeks prior to the commencement of ductwork installation. These drawings shall clearly indicate the location of all fire dampers, fire/smoke dampers, and access panels.
- 22.5.36 The contractor is responsible for coordinating all builder's work requirements, including penetrations and fire stopping, to facilitate the proper installation of fire dampers, fire/smoke dampers, and access panels. All fire stopping shall be completed with certified fire stopping products, and installed by certified installers, and certified upon completion.
- 22.5.37 Fire damper and fire/smoke damper frames shall be installed centrally within the thickness of the surrounding fire-rated wall or floor. In the case of thick walls or floors, the centreline of the frame shall be at least 50mm from the nearest face.
- 22.5.38 Where multiple ducts penetrate a fire-rated wall or floor, adjacent fire damper and fire/smoke damper assemblies shall be separated by fire-rated builder's work with a minimum fire resistance rating equivalent to the penetrated element, and a minimum thickness of 225mm, or as specified by the fire strategy.
- 22.5.39 All fire dampers and fire/smoke dampers shall be installed in accordance with the manufacturer's instructions and fire test evidence.
- 22.5.40 All fire and smoke dampers shall be tested post installation, and prior to handover, by a competent third party, and witnessed by the fire consultant and engineer representative.
- 22.5.41 All fire and smoke dampers must be included within the fire safety cert.
- 22.5.42 All Fire dampers & FSD's to be installed in compliance with all relevant codes and standards, or as detailed below.



- 22.5.43 Fire and smoke dampers shall be installed with breakaway duct connections on both the upstream and downstream sides, in accordance with the damper manufacturer's instructions and BS EN 1366-2.
- 22.5.44 Breakaway connections shall be achieved using one of the following methods, as approved by the fire safety engineer and in accordance with the damper manufacturer's instructions:
- Nylon bolts of a specified shear strength.
 - Flexible duct connections of a fire-resistant type.
 - Other manufacturer approved breakaway connection.
- 22.5.45 The breakaway connections shall be designed to allow the ductwork to detach from the damper frame during a fire, without compromising the integrity of the damper's closure.
- 22.5.46 The breakaway connections shall be designed to fail in a predictable and controlled manner, ensuring that the damper blades can fully close and maintain their fire resistance rating.
- 22.5.47 The contractor shall provide documentation from the damper manufacturer confirming that the breakaway connections have been tested and approved for use with the specified fire and smoke dampers.
- 22.5.48 The contractor must ensure the correct installation and orientation of the breakaway joint, as per the manufacturer's instructions.
- 22.5.49 The breakaway joints must be correctly supported, so that in the event of a fire, the collapsing ductwork does not put undue pressure on the damper itself.
- 22.5.50 Both the ductwork and the fire/smoke damper shall be independently supported. The support systems shall be designed to maintain the integrity of the ductwork and damper under fire conditions, and to prevent premature collapse. The support systems shall comply with BS EN 1366-1, BS EN 1366-8, BS EN 1366-9, and BS EN 1366-10, as applicable, and any relevant local building regulations.
- 22.5.51 Benchmark Installation
- 22.5.52 Prior to the commencement of full installation, the contractor shall construct a benchmark installation of a representative fire/smoke damper assembly, including breakaway connections, independent supports, and fire stopping.
- 22.5.53 The benchmark installation shall be located in a readily accessible area for review and inspection.
- 22.5.54 The benchmark installation shall be reviewed and approved by the following stakeholders:
- Fire Consultant
 - Design Engineer
 - Installer (Contractor's representative)
 - Damper Manufacturer's representative
 - Contractor's Fireproofing Specialist
 - Any other relevant parties as designated by the design engineer.
- 22.5.55 The benchmark installation shall demonstrate:
- Correct installation and orientation of the fire/smoke damper.

- Proper functioning of the breakaway connections.
- Adequate and independent support of the damper and ductwork.
- Correct installation of fire stopping materials and techniques.
- Correct installation of access panels.

22.5.56 Any required modifications or corrections identified during the benchmark installation review shall be implemented and re-inspected prior to the commencement of full installation.

22.5.57 The benchmark installation shall remain in place for the duration of the project as a reference for quality control.

22.5.58 A written report, including photographs, documenting the benchmark installation review and approval, shall be provided to all stakeholders.

22.5.59 Roof Cows

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

22.6 Testing & Commissioning

- 22.6.1 Air leakage tests for all ductwork systems shall be conducted in accordance with DW/144:2016, "Specification for Sheet Metal Ductwork." Testing shall be performed by a competent person and witnessed by the design engineer or their representative.
- 22.6.2 Testing shall be completed prior to the application of thermal insulation and cladding, and before the installation of ceiling systems, or any other building element that could prevent access to ductwork.
- 22.6.3 In addition to meeting the leakage rate requirements of DW/144:2016, the complete ductwork installation shall be free of audible leaks. Any audible leaks detected shall be rectified by the contractor at their own expense and retested.
- 22.6.4 The contractor shall provide a detailed test report, including test pressures, leakage rates, and any remedial actions taken.
- 22.6.5 The testing equipment used shall be calibrated, and calibration certificates shall be provided.
- 22.6.6 Fire and Smoke Damper Testing and Certification
- 22.6.7 All fire dampers and smoke/fire dampers shall be tested in accordance with BS 9999, BS EN 15650, and BS EN 1366-2.
- 22.6.8 The contractor shall provide certification from the damper manufacturer confirming that the dampers meet the required fire resistance ratings and performance criteria.
- 22.6.9 The contractor shall perform operational testing of all dampers, including manual and automatic actuation, and provide a test report documenting the results.
- 22.6.10 A competent third-party, or the fire safety officer, shall witness the testing of all fire and smoke dampers.
- 22.6.11 All fire and smoke dampers shall be tested after the installation of any ceilings, and before handover.
- 22.6.12 The contractor shall provide a schedule of all fire and smoke dampers, including their locations, types, and fire resistance ratings.
- 22.6.13 Airflow Measurement and Balancing
- 22.6.14 Airflow measurements and balancing shall be performed by a qualified commissioning specialist in accordance with CIBSE Commissioning Code A: Air Distribution.
- 22.6.15 Airflow rates shall be measured at all supply, return, and extract air terminals, and adjusted to match the design values.
- 22.6.16 The commissioning specialist shall provide a detailed commissioning report, including airflow measurements, balancing adjustments, and system performance data.
- 22.6.17 System Performance Testing
- 22.6.18 The complete ventilation system shall be tested under normal operating conditions to verify that it meets the design requirements for airflow, temperature, and pressure.
- 22.6.19 Noise levels shall be measured and verified to comply with the project's noise criteria.

- 22.6.20 All control systems shall be tested and verified to operate correctly.
- 22.6.21 Documentation
- 22.6.22 The contractor shall provide a complete set of testing and commissioning documentation, including test reports, certificates, and as-built drawings.
- 22.6.23 All documentation shall be submitted to the design engineer and the PSCS for approval.
- 22.6.24 Air leakage tests for all ductworks shall be tested in accordance with HVCA: DW144: 2016. 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.
- 22.6.25 All Fire Dampers & Smoke/Fire Dampers shall be certified by the contractor and the manufacturer.

22.7 Labelling

22.7.1 General Requirements

22.7.2 All ventilation system components, including but not limited to ductwork, equipment, dampers, access panels, and transformers, shall be clearly and permanently labelled for identification, operation, and maintenance.

22.7.3 Labelling shall be durable, legible, and resistant to environmental conditions, including temperature, humidity, and cleaning agents.

22.7.4 Labels shall be securely attached using appropriate methods, such as adhesive labels, engraved tags, or cable ties, as appropriate for the surface and environment.

22.7.5 All labelling shall align with the provided schematic drawings and plantroom layout diagrams.

22.7.6 Fire and Smoke Dampers

22.7.7 All fire dampers and smoke/fire dampers shall be clearly identified with durable tags indicating their location, identification number, fire resistance rating, and direction of airflow.

22.7.8 Labels shall be placed in visible locations adjacent to the dampers and on access panels.

22.7.9 A schedule of all fire and smoke dampers, including their locations and identification numbers, shall be provided to the client.

22.7.10 Ductwork Labelling

22.7.11 All ductwork shall be identified in accordance with DW/144:2016, Appendix B, "Ductwork Identification and Marking."

22.7.12 Labels shall indicate the system designation (e.g., supply air, return air, extract air), airflow direction, and ductwork size.

22.7.13 Labels shall be placed at regular intervals along the ductwork, at changes in direction, at penetrations through walls or floors, and at access panels.

22.7.14 Equipment Labelling

22.7.15 All ventilation equipment, including air handling units (AHUs), fans, and control panels, shall be labelled with their identification number, manufacturer, model number, and electrical supply details.

22.7.16 Labels for all equipment shall be Traffolyte labels or equivalent, engraved with the required information.

22.7.17 Labels shall be placed in visible locations on the equipment and on associated control panels.

22.7.18 Plantrooms shall have clear schematic diagrams displayed, that include the labeling of the installed equipment.

22.7.19 Volume Control Dampers (VCDs)

22.7.20 All VCDs shall be labelled with their identification number and location.

22.7.21 Labels shall be placed in visible locations adjacent to the dampers and on access panels.

22.7.22 The label shall include the design airflow rate.

22.7.23 Airflow Direction

22.7.24 Airflow direction shall be clearly indicated on all ductwork, diffusers, grilles, and fans using directional arrows or other appropriate markings.

22.7.25 Airflow direction markings shall be visible and durable.

22.7.26 Access Panels

22.7.27 All access panels for inspection and maintenance shall be clearly labeled with their purpose and the equipment or system they provide access to.

22.7.28 Schematics and Plantroom Layouts

22.7.29 The contractor shall furnish and install A1-sized, high-resolution printed schematic diagrams of all ventilation systems. These diagrams shall accurately depict the location and labelling of all components and shall be printed on a rigid, durable substrate. The completed diagrams shall be mounted within a protective, clear, anti-glare, and impact-resistant frame.

22.7.30 Plantroom layout diagrams, conforming to the same A1-sized, framed specifications, shall be provided to clearly illustrate the location and labelling of all plantroom equipment.

22.8 Documentation

22.8.1 Operation and Maintenance Manuals and As-Built Drawings

22.8.2 Upon project completion, the contractor shall provide comprehensive Operation and Maintenance (O&M) manuals, including detailed "as-built" drawings, for all installed systems. These documents shall be provided in both electronic (PDF) and hard copy formats.

22.8.3 The O&M manuals shall include detailed instructions for the operation, maintenance, and troubleshooting of all equipment and systems.

22.8.4 The "as-built" drawings shall accurately reflect the final installed configuration of all systems, including ductwork layouts, equipment locations, and control system arrangements.

22.8.5 Ventilation System Documentation

22.8.6 The contractor shall provide the following documentation for all ventilation installations:

22.8.7 Ductwork Pressure Test Results:

- Date of test
- Test pressure
- Duration of test
- Leakage rate (measured and allowable)
- Testing standard applied (DW/144:2016)
- Calibration certificates for testing equipment
- Signatures of the contractor's witness and the design engineer's representative witness.

22.8.8 Fire and Smoke Damper Certification and Test Reports:

- Date of test/inspection
- Manufacturer's certification of compliance with relevant standards (BS EN 15650, BS EN 1366-2, BS 9999)
- Operational test results (manual and automatic actuation)
- Third party witness conformation of testing.
- Schedule of damper locations and fire ratings
- Signatures of the contractor's witness, the design engineer's representative witness, and any third-party witness.

22.8.9 Commissioning Results:

- Date of commissioning
- Design airflow rates and pressure drops
- Commissioned airflow rates and pressure drops
- Balancing adjustments made
- Calibration certificates for measuring instruments
- CIBSE Commissioning Code A compliance report.

22.8.10 Noise Data:

- Date of test
- Location of test points
- Design noise rating (NR)
- Commissioned noise rating (NR)
- Full spectrum noise data (frequency analysis)
- Testing standards applied.
- Equipment used, and calibration certificates.

22.8.11 Equipment Data Sheets and Manuals:

- Manufacturer's data sheets and manuals for all installed equipment.

22.8.12 Control System Documentation:

- Control system schematics and wiring diagrams.
- Control system programming documentation.
- Control system test reports.
- Control system operation instructions.

22.8.13 Labelling Schedule:

- A full list of all installed labels, and their locations.

22.8.14 Fire stopping certification:

- Documentation relating to all fire stopping that has been completed.

22.9 Appendix A: Schedule of Volume Control Dampers

22.9.1 Contractor shall refer to the M20 Layouts, Schematics and associated Schedules

22.10 Appendix B: Schedule of Fire Smoke Dampers

22.10.1 Contractor shall refer to the M20 Layouts, Schematics and associated Schedules

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23.1 Outline Description

- 23.1.1 The Contractor shall be responsible for the supply, installation, commissioning of all DX air conditioning units and ancillary components as detailed on IN2 Engineering Design Partnership Drawings.
- 23.1.2 The Contractor shall be responsible for the supply, installation, commissioning of the complete Hybrid Variable Refrigerant Flow air conditioning system including all necessary pipework and ancillary components as indicated on IN2 Engineering Design Partnership M70 series drawings.
- 23.1.3 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.
- 23.1.4 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.
- 23.1.5 The Mechanical Contractor shall be responsible for the Design, Selection and installation of the complete DX Air-conditioning system, based on the following performance specification. The Contractor shall be responsible for determining the appropriate condenser & refrigerant pipework (inc ancillaries) required to meet the AC unit capacities (over site specific conditions, piping lengths, condenser locations etc). All external condensers should be sized for not less than 100% of internal capacities.
- 23.1.6 The system shall be a refrigeration system capable of simultaneous heating and cooling operation. The system shall consist of outdoor units, indoor units, branch controllers, and associated pipework and accessories.
- 23.1.7 The Mechanical Contractor shall include for the following:
- DX Outdoor Units (suitable for Marine Environment).
 - Refrigerant Cable Tray and associated pipework
 - Remote Controllers and Master Control Panel
 - Air-Conditioning Control Cable
 - Leak Detection system.
- 23.1.8 Air-Conditioning System to Serve the Comms Room. Including Indoor and Outdoor Units suitable for Marine Environment, Refrigerant Cable Trunking, Remote Controllers, Air-Conditioning Control Cable, BACNET BMS Interface and Big Foot Support System suitable for Marine Environment

- 23.1.9 Air-Conditioning System to Serve the Roscommon University Hosipital. Including Indoor and Outdoor Units suitable for Marine Environment, Refrigerant Cable Trunking, Remote Controllers, Air-Conditioning Control Cable, BACNET BMS Interface and Big Foot Support System suitable for HSE Environment.
- 23.1.10 The Mechanical Contractor shall be responsible for the Design, Selection and installation of the complete split Air-conditioning system, based on the following performance specification. The Contractor shall be responsible for determining the appropriate condenser & pipework (inc ancillaries) required to meet the AC unit capacities (over site specific conditions, piping lengths, condenser locations etc). All external condensers should be sized for not less than 100% of internal capacities.
- 23.1.11 The system shall be a split AC system in the room areas capable of simultaneous heating and cooling operation. The system shall consist of outdoor units, indoor units, and associated pipework and accessories.
- 23.1.12 The Mechanical Contractor shall include for the following:
- 23.1.13 Ceiling Concealed Units Med ESP, including condensation pump and associated controllers with master panel interface.
- 23.1.14 Cable Tray and associated pipework
- 23.1.15 Remote Controllers and BMS control Module
- 23.1.16 Air-Conditioning Control Cable

23.2 Standards

23.2.1 The first aid firefighting devices, and cabinets, shall comply with the requirements of the following standards:

BS EN 378-1_2016 Refrigerating systems and heat pumps. Safety and environmental requirements. Basic requirements, definitions, classification and selection criteria

BS EN 378-2_2016 Refrigerating systems and heat pumps. Safety and environmental requirements. Design, construction, testing, marking and documentation

BS EN 378-3_2016 Refrigerating systems and heat pumps. Safety and environmental requirements. Installation site and personal protection

BS EN 378-4:2016 Refrigerating systems and heat pumps. Safety and environmental requirements. Operation, maintenance, repair and recovery

BS EN 14825:20 Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling. Testing and rating at part load conditions and calculation of seasonal performance

IEC 60335-2-40 2024 Household and similar electrical appliances - Safety - Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers

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.

23.3 Equipment

- 23.3.1 The Air conditioning systems shall be designed, installed and commissioned by a refrigeration specialist. The contractor shall provide a project-specific Refrigerant Charge Calculation for every room/zone to demonstrate and confirm compliance with EN 378 and the Practical Limit requirements for R32.
- 23.3.2 The entire system shall be installed in accordance with EN 378 IEC 60335-2-40, and relevant F-Gas regulations. A DSEAR (Dangerous Substances and Explosive Atmospheres Regulations) risk assessment must be submitted for any area where the refrigerant charge exceeds the calculated safety threshold.
- 23.3.3 IEC 60335-2-40, and relevant F-Gas regulations.
- 23.3.4 All air-conditioning control panels shall come complete with temperature wired back to BMS.
- 23.3.5 All air-conditioning units shall come complete with BMS interface, for monitoring purposes.
- 23.3.6 The Refrigerant system shall be equipped with fully integrated refrigerant leak detection. The leak detection system shall provide continuous monitoring of the refrigerant circuit. Upon detection of a refrigerant leak, the system shall automatically initiate an alarm and shut down the affected section of the system. The leak detection system shall provide both audible and visual alarms. The leak detection system shall be integrated with the BMS via BACnet, providing remote alarm notification.
- 23.3.7 The installation will comprise multi split air conditioning system. The system will utilise air cooled condensing units capable of supplying up to two indoor units. The system will be capable of simultaneously heating and cooling via one or two manifold controllers using only two pipes to the indoor units.
- 23.3.8 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.
- 23.3.9 Air Conditioning System
- 23.3.9.1 All Air conditioning systems shall be split air conditioning systems.
- 23.3.9.2 The Air conditioning systems shall be designed, installed and commissioned by a refrigeration specialist.
- 23.3.9.3 All internal air conditioning units shall be capable of cooling and heating, operating with refrigerant R32 and be supplied and installed complete with all interconnecting piping, built-in condensate drain pump, condensate drain piping, interconnecting wiring, controls and ancillaries.
- 23.3.9.4 Air conditioning units shall be suitable for maximum piping distance between internal units and external condensers of 50m.
- 23.3.9.5 The indoor air conditioning units shall be capable of control of the supply air temperature between 10°C and 26°C using off coil sensors.

- 23.3.9.6 All outdoor units shall be manufactured from corrosion resistant materials suitable for the HSE Environment along with the appropriate protection from the coastal environmental contaminants to avoid against corrosion.
- 23.3.9.7 All outdoor units should be selected based on Irish conditions and shall not exceed 100% capacity connection.
- 23.3.9.8 All external air conditioning units shall incorporate high efficiency scroll compressors, with low noise/ vibration.
- 23.3.9.9 Air conditioning units shall incorporate advanced fuzzy logic control for refrigerant capacity control dependent on internal and external temperature conditions.
- 23.3.9.10 All air-conditioning units shall have a specific fan power of less than 2W/Ltr.s-1
- 23.3.9.11 Air conditioning units shall be wall mounted. Air conditioning units shall be complete with wired local controllers for each internal unit.
- 23.3.9.12 The entire system shall be installed in accordance with EN 378.
- 23.3.9.13 All air conditioning units shall be complete with 'auto restart' functions.
- 23.3.9.14 All air-conditioning control panels shall come complete with high temperature alarms wired back to BMS.
- 23.3.9.15 Please see IN2 Engineering BMS Specification for description of required controls system.
- 23.3.9.16 All air-conditioning units shall come complete with BMS interface, for control and monitoring purposes.
- 23.3.9.17 The Refrigerant system shall be equipped with fully integrated refrigerant leak detection. The leak detection system shall provide continuous monitoring of the refrigerant circuit. Upon detection of a refrigerant leak, the system shall automatically initiate an alarm and shut down the affected section of the system. The leak detection system shall provide both audible and visual alarms. The leak detection system shall be integrated with the BMS via BACnet, providing remote alarm notification.
- 23.3.9.18 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.
- 23.3.10 Refrigerant Pipework Installation
- 23.3.10.1 All refrigerant pipework to be carried out in refrigerant quality soft/medium drawn copper tubing to BS2871 Part 2: 1972 and complete with the appropriate headers and joints.
- 23.3.10.2 Pipework should be carried out by an Approved (certificate approval must be submitted prior to installation commencement) Refrigerant Engineer and accordance to BS EN 378 2000 Specification (or latest version if updated) and manufacturers design and installation instructions.
- 23.3.10.3 Longest possible lengths of copper pipe should be utilised to minimise joints on site.

- 23.3.10.4 Appropriate refrigeration installation tools must be utilised. Dry Nitrogen must be utilised at all times in the system during brazing.
- 23.3.10.5 All pipework (suction and liquid lines) to be insulated with slip on close cell elastomeric pipe insulation (as manufactured by Armaflex or equal and approved) with a fire performance class 0 of the 1985 building regulations, having a wall thickness of not less than 13mm.
- 23.3.10.6 Following installation of pipework, and prior to sealing of insulation joints and starting of equipment, pipework should be pressure tested to 28Kg/cm. sq (430psi), held for 24 hours, and checked for leaks, vacuumed/dehydrated to (-752mm Hg) 2 torr, and held at that setting for 12 hours (minimum).
- 23.3.10.7 Refrigerant (R32) charge weight must be calculated, to the actual installed length of pipework in accordance with manufacturer's recommendations.
- 23.3.10.8 The charging should be carried out with an appropriate charging station.
- 23.3.10.9 Pipework to be properly fixed and supported at a minimum of 1.5 metres centres and run-on galvanised trays throughout. All pipework to be labelled with ID number (condensing unit's ref.) at 3 metre intervals.
- 23.3.10.10 Joints in copper pipe shall be brazed. Brazing shall be carried out to the requirements of the HVCA Code of Practice – Brazing and Bronze Welding of Copper Pipe and Sheet.
- 23.3.11 Pipework Insulation
- 23.3.11.1 All concealed and exposed 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.
- 23.3.11.2 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.
- 23.3.11.3 The insulation shall achieve a thermal conductivity of 0.033W/m. K at 10Deg C and comply with BS 5422:2009. The aluminium foil covering shall achieve a maximum vapour permeance of 0.00024g/s.MN.
- 23.3.11.4 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.
- 23.3.11.5 Insulated Pipe Support Inserts shall be used, and the Pipe Support Bracket be fixed overload bearing insulation of the same material (or compatible with) the insulation on the pipe.
- 23.3.11.6 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.

- 23.3.11.7 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:
- 23.3.11.8 Temperature Range: 10 degrees C to 230 degrees C.
- 23.3.11.9 Inner Face: 430g single sided silicone. (Insulation to achieve a thermal conductivity of 0.033W/m.K. The aluminium foil covering shall achieve a maximum vapour permeance of 0.00024g/s.MN.)
- 23.3.11.10 Outer Face: 430g single sided silicone.
- 23.3.11.11 Fasteners: Velcro type hooks and loop flaps, 25mm D-rings complete with clinch straps are optional.
- 23.3.11.12 Draw Cord: 4mm spun fiberglass cord.
- 23.3.11.13 Quilts: 100mm Stainless Steel.
- 23.3.11.14 Thread: PTFE coated glass fibre thread.
- 23.3.11.15 ID Label: Laminated.
- 23.3.12 Supports
- 23.3.12.1 The refrigeration installation shall conform to BS EN 378-2:2016, including any subsequent amendments. The installation shall also conform to the Code of Practice as published by the Institute of Refrigeration.
- 23.3.12.2 The pipework shall be supported with spacing of each support no less than 1m for 3/8" to 7/8" soft copper and 2m for 1/2" to 2 1/8" half hard copper.
- 23.3.12.3 If slotted cable tray is to be used, then the pipework shall be tie wrapped to the tray and the tray shall be supported as detailed later in this specification.
- 23.3.12.4 The pipework shall be supported with adequately sized supports to carry the weight of the pipework, insulation and the contents of the pipe.
- 23.3.12.5 The contractor is to include for a uni-strut support system for each condenser, to be mounted so the condenser is raised from the ground and is easily accessible for maintenance.
- 23.3.13 Fittings and Brazing
- 23.3.13.1 Socket fittings shall be used for half hard pipework.
- 23.3.13.2 The number of brazed fittings shall be kept to the minimum.
- 23.3.13.3 Bending shall only be used on fully annealed tubing and elbow fittings shall be used on half tubing.
- 23.3.13.4 All fittings shall be silver soldered.

- 23.3.13.5 To prevent scaling, all brazed joints shall be made with nitrogen passing through the pipework.
- 23.3.13.6 Brazing shall be done with the use of a non-ferrous filler metal or alloy which shall have high melting point. BS. 2871 shall apply to socket fittings for half hard pipework and brazing shall be in accordance with B.S. 1723. All brazing operators shall be qualified to carry out such works. Only diaphragm type, bellow type or packed valves shall be used for compressors, liquid receivers etc. Each valve shall have back seating and a seal cap.
- 23.3.14 Insulation
- 23.3.14.1 Insulation for refrigeration system shall conform to BS 806, BS 5422 and BS 476 Parts 6, 7 and 12.
- 23.3.14.2 Only Class 'O' fire performance insulation shall only be used, as manufactured by Armstrong.
- 23.3.14.3 Insulation shall be used as directed by the refrigeration plant manufacturers. The insulation shall be run along the entire length of the suction line.
- 23.3.14.4 All joints in the insulation shall be made with Armaflex non-flame adhesive manufactured by Armstrong. No gaps shall be permitted along the entire length of the insulation run.
- 23.3.14.5 All components in contact with refrigerant must be suitably compatible with that refrigerant. Any alloy or zinc with more than 2% magnesium shall not be allowed to be used in contact with any refrigerant. All compressors shall have pressure safety cut outs, which shall be manually reset only. Automatic reset for high pressure cut outs shall not be permitted. An automatic reset low pressure cut out shall be provided to each compressor. All condensing units shall be factory fitted with head pressure control, crank case oil heater, shut off valves and a dryer.
- 23.3.15 Cable Tray
- 23.3.15.1 The contractor shall supply and install in the locations as indicated on the drawings a cable tray network for all refrigerant pipework services throughout the building including vertical rises to all floor level.
- 23.3.15.2 Adequate supports shall be provided for cable tray systems. It shall be the responsibility of the contractor to estimate the extent of supports required taking due cognisance of the weights of the pipework and cable tray to be supported.
- 23.3.15.3 Cable tray support systems shall be formed using a proprietary galvanised metal framing channel system.
- 23.3.15.4 The framing members shall be in the form of cold rolled steel return edge U-channel with integral spring retained nuts.
- 23.3.15.5 Fixing and supports shall be installed at regular intervals not exceeding 1200mm and not more than 150 mm from bends, tees and intersection and couplers. A minimum clear space of 40 mm shall remain behind all runs of cable tray and trunking.
- 23.3.15.6 Cable trays in ceiling voids shall be supported using a Trapeze type bracket arrangement as follows. A length of channel shall be bolted to the slab using suitable anchor bolts. Two or more threaded rods shall be screwed into the nuts of the channel to support a similar length of channel onto which the cable trays and trunkings shall be fixed.

- 23.3.15.7 A minimum space of 50 mm shall be maintained between each different tray or trunking.
- 23.3.15.8 The supporting channels shall be equal to 1.5 times the resulting overall width of the trays, trunkings and spaces.
- 23.3.15.9 Cable trays shall be supported on walls of service ducts and corridors using cantilever brackets as follows.
- 23.3.15.10 A length of channel shall be bolted to the wall using suitable anchor bolts. A proprietary cantilever arm shall be bolted to the channel nuts onto which the cable trays and trunkings shall be fixed.
- 23.3.15.11 Cable trays shall be the perforated type, manufactured from cold rolled steel in accordance with B.S. 1449. All accessories including bends, intersections, tees, risers and reducing sections shall be purpose made by the tray manufacturer.
- 23.3.15.12 Only one manufacturer's tray and accessories shall be used on the project.
- 23.3.15.13 Cable tray sizes as indicated shall be deemed to be the minimum sizes acceptable. The specialist shall satisfy himself that all sizes are adequate and shall include for larger cable trays if necessary.
- 23.3.15.14 The minimum thickness of medium duty cable trays and accessories shall be as follows:
- | Width of Tray Accessory (mm) | Minimum Thickness (mm) |
|------------------------------|------------------------|
| Up to and including 150 | 1.0 |
| 150 up to and including 250 | 1.2 |
| 250 up to and including 450 | 1.6 |
| 450 up to and including 910 | 2.0 |
- 23.3.15.15 Where heavy duty cable tray is specified the minimum thickness of cable tray and accessories shall be as follows:
- | Width of Tray Accessory (mm) | Minimum Thickness (mm) |
|------------------------------|------------------------|
| Up to and including 450 | 1.6 |
| 450 up to and including 900 | 2.0 |
- 23.3.15.16 Heavy duty cable trays shall be manufactured with plain return flanges. Except where specified or shown otherwise the specialist shall be responsible for the selection of the correct grade of cable tray to carry the specified pipes.
- 23.3.15.17 Sections of cable tray and accessories shall be jointed in accordance with the recommendations of the manufacturers using M6 galvanised gutter bolts, nuts and washers.
- 23.3.15.18 Cable tray and accessories shall be supplied with a hot-dip galvanised finish to B.S. 1461. Any damage caused to the tray, shall be made good using a zinc epoxy primer or equal alternative.
- 23.3.15.19 Cable trays shall be cut along a line of plain metal and not through perforations. Burrs or sharp edges shall be removed prior to the installation of tray sections or accessories.

- 23.3.15.20 Holes cut in cable tray shall be suitably bushed. Fixings and supports shall be installed at regular intervals of 1200 mm and not more than 150 mm from all bends, tees, intersections and risers.
- 23.3.15.21 Midspan joints between cable tray sections shall be avoided and shall be positioned as close as practicable to the tray fixing or support. A minimum clear space of 40 mm shall remain behind all installed runs of cable tray.
- 23.3.15.22 Pipework shall be installed on trays in a single layer, leaving 25% of the tray width space for future use.
- 23.3.15.23 Pipework shall be fixed to trays using purpose made straps, cleats or saddles to maintain a neat and regular disposition of cables.
- 23.3.15.24 Where trays do not directly support pipework, e.g. vertical tray, load bearing cable cleats or saddles shall be employed to securely fix the cables to the tray.
- 23.3.15.25 Where cable tray crosses structural expansion joints, the tray shall be cut and supported on either side of the joint. The tray sections shall then be joined with couplers allowing a lengthwise movement of 10 mm. Vertical runs of cable tray shall not cross vertical expansion joints.
- 23.3.15.26 The noise level of all units on high speed fan shall not exceed NC40 at 1 m.
- 23.3.15.27 General Description: The leak detection system shall be designed to continuously monitor the refrigerant circuit of the AC system for potential leaks. The system shall provide an early warning to prevent efficiency loss, equipment failure, and environmental hazards due to refrigerant leakage.
- 23.3.16 Leak Detection
- 23.3.16.1 Performance Requirements:
- The system shall detect refrigerant leaks at a minimum sensitivity level compliant with industry standards.
 - It shall operate within a temperature range suitable for AC system environments.
 - The system shall provide real-time monitoring and alert notifications upon detection of leaks.
 - The detection method shall be non-invasive and shall not interfere with the normal operation of the AC system.
 - The system shall be capable of interfacing with existing Building Management Systems (BMS) via industry-standard communication protocols.
- 23.3.16.2 System Components:
- Detection Sensors: Sensors shall be capable of identifying refrigerant presence at low levels with high accuracy and reliability.
 - Control Unit: A centralized processing unit shall analyze sensor data, trigger alarms, and communicate with external monitoring systems.
 - Alarm and Notification System: Audible and visual alarms shall be included, along with an option for remote notifications via BMS integration.
 - Power Supply: The system shall operate on standard electrical power available at the installation site, with battery backup options if necessary.

- Enclosure and Mounting: Enclosure shall be suitable for the environmental conditions of the installation site and provide easy access for maintenance.

23.3.16.3 Installation Requirements:

- Sensors shall be strategically placed in areas where refrigerant leaks are most likely to occur, including connection points, valves, and compressor units.
- The control unit shall be installed in a location that allows easy access for maintenance and integration with the BMS.
- Wiring and communication cabling shall conform to local electrical codes and standards.
- Installation shall be carried out by qualified personnel in accordance with manufacturer recommendations and industry best practices.

23.3.16.4 Operational Requirements:

- The system shall perform self-diagnostic checks to ensure operational integrity.
- System calibration shall be required periodically, with calibration intervals clearly defined in the operational manual.
- The system shall include logging capabilities to store historical leak events for analysis.

23.3.16.5 Compliance and Standards:

- The leak detection system shall comply with applicable local, national, and international AC and refrigerant safety regulations.
- The system shall be designed to meet industry-standard requirements for refrigerant monitoring and detection.
- Components shall be UL-listed or equivalent and meet necessary environmental protection standards.

23.3.16.6 Maintenance and Support:

- The system shall include clear maintenance guidelines for periodic sensor calibration and overall system checks.
- Manufacturer shall provide technical support and documentation for troubleshooting and system integration.

23.3.16.7 Warranty and Service:

- The leak detection system shall come with a minimum warranty period covering parts and labor.
- Optional extended service plans shall be available for continued system support and maintenance.
- This specification ensures that the AC system leak detection solution is properly designed, installed, and maintained to enhance safety, efficiency, and compliance with regulatory requirements.

23.4 Construction Products Regulations

- 23.4.1 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.
- 23.4.2 All products where applicable must comply with relevant Harmonised European Standards (hENs)
- 23.4.3 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.
- 23.4.4 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.
- 23.4.5 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.
- 23.4.6 Ancillary Certificates of Compliance are required from "Specialist" contractors i.e. Air Conditioning Refrigerant Specialist.
- 23.4.7 These ancillary certificates must comply with the suite of certificates developed by RIAI, ACEI, Engineers Ireland and SCSi specifically:
- Ancillary Certificate Compliance: Design (Commencement / 7 Day Notice)
 - Ancillary Certificate Compliance: Design (Completion)
 - Ancillary Certificate Compliance on Completion
- 23.4.8 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.
- 23.4.9 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.

- 23.4.10 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.

23.5 Samples & Technical Submittals

- 23.5.1 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.
- 23.5.2 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.
- 23.5.3 The contractor shall be responsible for determining quantities from IN2 Engineering Design Partnership drawings and specifications.
- 23.5.4 The contractor shall liaise with the various specialist suppliers to ensure that all necessary fixings kits, supports, connections, etc. are included.
- 23.5.5 The contractor shall refer to IN2 Engineering Mechanical Specification, Section M00 General Specification, part 00.5 "Production of Information - Procurement Details".
- 23.5.6 The contractor shall refer to IN2 Engineering Mechanical Contract Particulars, Section 2.5 Submittal of Alternatives & Section 2.7 Value Engineering.
- 23.5.7 All technical submittals shall be issued in the following format.
- 23.5.8 A full index of items, date & revision number of submittal shall be included on the submittal title page.
- 23.5.9 All manufacturers / Suppliers' schedules shall refer to IN2 item references.
- 23.5.10 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:
- 23.5.11 "Manufacturer / Supplier Initial" & "Compliant" or "Non-Compliant".
- 23.5.12 Should a line item prove non-compliant to spec, the manufacturer / supplier shall include details of proposed alternative.
- 23.5.13 Expected lead-in times shall be included for all items.
- 23.5.14 Where applicable contractor shall propose date for reviewing / approving samples on site.
- 23.5.15 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.

23.6 Approved Manufacturers and Vendors

- 23.6.1 The following manufacturers may be considered for the provision of the DX air conditioning
- Mitsubishi Electric or equivalent
- 23.6.2 Alternative products / systems will be considered if the contractor can demonstrate that the proposed alternative is equivalent to that specified in all 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.

23.7 Installation

- 23.7.1 All DX air conditioning equipment shall be installed as indicated on IN2 Engineering Design Partnership Drawings.
- 23.7.2 All air conditioning equipment shall be installed as indicated on IN2 Engineering Design Partnership Drawings.
- 23.7.3 Mechanical contractor shall be responsible for the installation of pumped condensate drainage.
- 23.7.4 Contractor shall be responsible for ensuring proper coordination of all refrigerant & condensate drainage pipework.
- 23.7.5 All interconnecting refrigerant and condensate drain pipework shall be routed in a concealed manner.
- 23.7.6 Contractor shall be responsible for erection of all refrigeration equipment. All grounds / builders work shall be the responsibility of the mechanical contractor to coordinate with main contractor.
- 23.7.7 All equipment and ancillary components must be selected from the same manufacturers range.
- 23.7.8 All external pipework shall be enclosed within cable trunking with a priority accessible secured lid.
- 23.7.9 Refrigerant pipework shall be installed in accordance with manufacturer's recommendations and industry best practices. Pipework shall be insulated to minimise energy losses and prevent condensation. The refrigerant circuit shall be designed by the air conditioning specialist to minimise refrigerant charge and potential leak points. All joints shall be made using approved brazing techniques. The contractor shall perform pressure testing and vacuum dehydration of the refrigerant circuit.
- 23.7.10 The contractor shall be responsible for the complete installation, testing, and commissioning of the refrigerant system. All installation work shall be carried out by qualified and experienced air conditioning refrigeration personnel

23.8 Testing & Commissioning

- 23.8.1 The Mechanical Contractor shall include for full commissioning of all DX air-conditioning and refrigeration equipment. Commissioning data shall include flowrates and pressure drops for each system.
- 23.8.2 The Mechanical Contractor shall include for full commissioning of all DX air-conditioning and , HVRF equipment. Commissioning data shall include flowrates and pressure drops for each system.

23.9 Labelling

- 23.9.1 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: 2014 with colours to BS 4800: 2011.
- 23.9.2 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.
- 23.9.3 Suppliers shall be requested to label all equipment and packages with identification numbers, to ensure items can be correctly identified.
- 23.9.4 All equipment shall be individually numbered and identified by means of 'traffo labels' securely fixed to the units.

23.10 Documentation

- 23.10.1 Upon project completion the contractor shall provide complete Operation and Maintenance instructions with "As installed" drawings.
- 23.10.2 The contractor shall provide the following documentation for all heating and chilled water installations.
- Complete pipework pressure test results indicating:
 - Date of test
 - Test pressure
 - Duration of test
 - Signatures of the contractors witness and engineer's representative witness.
 - Complete commissioning results indicating:
 - Date of commissioning
 - Design flowrates and pressure drops
 - Commissioned flowrates and pressure drop.

23.11 Appendix A: DX Indoor Air Conditioning Unit Schedule

23.11.1 Contractor shall refer to the M70 Layouts, Schematics and associated Schedules

23.12 Appendix B: DX Outdoor Air Conditioning Unit Schedule

23.12.1 Contractor shall refer to the M70 Layouts, Schematics and associated Schedules

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31.2 Outline Description

- 31.2.1 The Mechanical Contractor shall be responsible for the complete supply, installation, and testing of all water services systems as detailed on the IN2 Engineering Design Partnership drawings. This includes, but is not limited to:
- Supply and Installation of the cold and hot water services pipework, fittings, valves and supports.
 - Installation and Connections of all water services to all sanitary ware and Mechanical Equipment.
 - Pipework insulation
 - Labelling and tagging of pipework and equipment.
 - Testing, flushing, commissioning of the complete water services system.
 - Handover documentation.
- 31.2.2 The domestic water services (excluding Mains Water Services) installations shall comprise brazed and capillary copper pipework throughout the building.
- 31.2.3 In accordance with the European Union (Drinking Water) Regulations 2014, and to minimise the risk of metallic exceedances, particularly lead and copper, the mains water distribution system throughout the building shall utilize a complete non-metallic pipework solution.
- 31.2.4 The Mechanical Contractor shall be responsible for the supply and installation, of all water services, and all ancillaries, as detailed as indicated on IN2 Engineering Design Partnership drawings.
- 31.2.5 The arrangement and size of all water services pipework and fittings as required shall be as shown on IN2 Engineering Design Partnership drawings and where necessary, as agreed with the Engineers on site.
- 31.2.6 All flow meters to be provided free issue from BMS controls contractor and installed by mechanical contractor.
- 31.2.7 The Mechanical Contractor shall be responsible for the Design, Selection and installation of the complete support & Bracketry systems (inc Anti-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.
- 31.2.8 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.
- 31.2.9 The Mechanical Contractor shall carefully read the notes on the drawings and include for all associated costs in his tender.

- 31.2.10 The supply and erection of sanitary fittings shall be by the mechanical contractor and include for all necessary fittings/pipework transitions required to make final connections to fittings., connections to etc.

31.3 Standards

31.3.1 The copper pipework shall be fabricated to R250 material temper ("half hard") and shall comply with the requirements of the following standards:

IS EN 1057: 2006 + A1: 2010	Copper and copper alloys - seamless, round copper tubes for water and gas in sanitary and heating applications
BS EN 1254-1:1998	Copper and copper alloys. Plumbing fittings. Fittings with ends for capillary soldering or capillary brazing to copper tubes
BS 1710: 2014	Specification for identification of pipelines and services
BS 5970: 2012	Thermal insulation of pipework, ductwork, associated equipment and other industrial installations in the temperature range of -100°C to +870°C. Code of practice
BS 5422:2009	Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C.
EN 1074: 2000 Pt.1-5:	Valves for water supply.
BS EN ISO 4126-1:2013+A2:2019	Safety devices for protection against excessive pressure. Safety valves
BS EN 1490	Building valves. Combined temperature and pressure relief valves. Tests and requirements
EN ISO 837	Pressure Gauges.
BS 759-1	Valves, gauges and other safety fittings for application to boilers and to piping installations for and in connection with boilers.
BS EN 13190:2001	Dial thermometers
BS 1710 :2014	Specification for identification of pipelines and services
WRAS Approval:	All products in contact with potable water shall have current WRAS approval.
Legionella Control:	Compliance with relevant local health authority guidelines and implementation of a water safety plan to minimise Legionella risk.
BS EN 806-2:2005	Specification for installations inside buildings (Potable)
S.I. No. 99/2023	European Union (Drinking Water) Regulations 2023
BS EN 15874-2:2013+A1:2018	Plastics piping systems for hot and cold water (PP).

31.4 Equipment

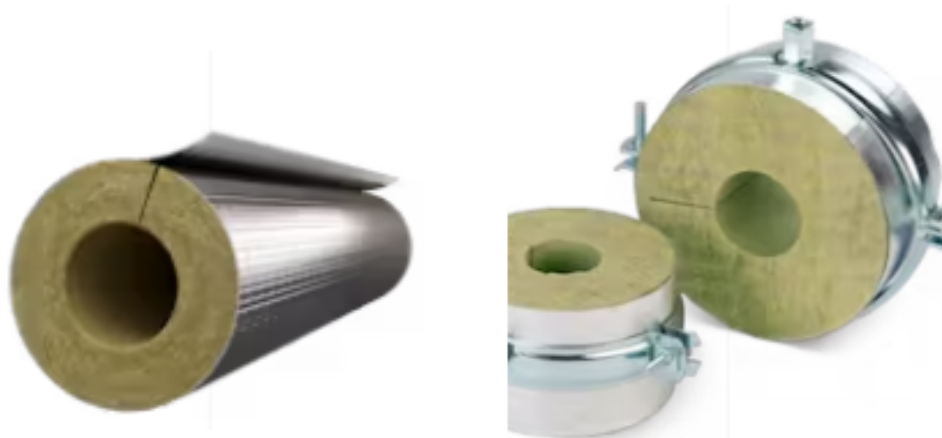
31.4.1 Cold and Hot Water Services Pipework

- 31.4.1.1 All water services pipework shall be copper to R250 material temper ("half hard").
- 31.4.1.2 All pipework shall be provided with Certificate of Conformity and Regulation 31 of The Water Supply (Water Quality) Regulations 2016 (as amended) implements Article 10 of the Council of the European Union Drinking Water Directive (DWD) for all chemicals and construction products used by water undertakers, from the source of the water, up to the point of delivery to the consumer's building.
- 31.4.1.3 All pipework shall be stored clear of the ground and shall be suitably protected from the weather. Open ends of tubes shall be protected with a socket or plastic thimble.
- 31.4.1.4 All pipework fittings and joints of Ø54mm and below shall be of the capillary type. Threaded or flanged joints shall only be allowed where required for connecting to piping accessories, equipment, etc. No compression fittings shall be used.
- 31.4.1.5 All capillary joint solders shall be tin/ copper or tin/ silver based. No lead composites shall be used.
- 31.4.1.6 All pipework fittings and joints of Ø67mm and above shall be brazed type. Threaded or flanged joints shall only be allowed where required for connecting to piping accessories, equipment, etc. No compression fittings shall be used.
- 31.4.1.7 All brazed joints shall use silver brazing filler alloy. No lead composites shall be used.
- 31.4.1.8 All thermostatically mixed water supplies shall have a maximum pipe length of 1m from thermostatic mixing valve to outlet connection.
- 31.4.1.9 All hot water supplies shall have a maximum 'dead leg' pipe length of 1m from hot water service return connection to outlet connection.
- 31.4.1.10 Equivalent systems must:
 - Be fully compliant with EN ISO 21003.
 - Provide independent certification of compliance with WRAS or DVGW standards.
 - Have a proven track record of successful installations for a minimum of 5 years.
 - The contractor shall submit full details of the proposed equivalent system, including technical specifications, certifications, and references, to the engineer for approval at least 4 weeks prior to ordering.

31.4.2 Pipework Insulation

- 31.4.2.1 All concealed water services pipework, valves and fittings shall be insulated with preformed rigid stone wool 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.
- 31.4.2.2 The mineral wool insulation shall be non-combustible to Euro Class A2, s1, d0 RtF according to EN13501-1. All pipework insulation shall be accordance with the current Building Regulations Part B.

- 31.4.2.3 Mechanical contractor shall provide insulated Pipe Supports Inserts. Pipe supports shall be manufactured from high-density phenolic insulation and rated for the temperature of the pipe they are supporting. Each support shall be supplied with a factory-applied aluminium foil vapour barrier. All pipe supports inserts shall comply with EN14314.



- 31.4.2.4 The insulation shall achieve a thermal conductivity of 0.033W/m.K at 10Deg C and comply with BS 5422:2009. The aluminium foil covering shall achieve a maximum vapour permeance of 0.00024g/s.MN.
- 31.4.2.5 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.
- 31.4.2.6 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 a 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 the fire classification requirements of EN 13501-1. Valve blankets shall achieve a minimum classification of B-s1, d0 according to EN 13501-1. 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 0.033W/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.
- 31.4.2.7 The contractor shall provide samples of the valve blankets to the engineer for approval prior to manufacture.
- 31.4.2.8 Water services pipework insulation thicknesses shall conform to BS 5422:2009 the tables below:
- 31.4.2.9 The insulation shall achieve a thermal conductivity of 0.033W/m.K at 10Deg C and comply with BS 5422:2009. The aluminium foil covering shall achieve a maximum vapour permeance of 0.00024g/s.MN.
- 31.4.2.10 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.
- 31.4.2.11 All valve blankets shall achieve a minimum Euroclass rating of B-s1, d0 according to EN 13501-1. The materials used in the valve blankets shall also meet the requirements of the current Building Regulations Part B regarding fire safety.

- 31.4.2.12 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 achieve a minimum Euroclass rating of B-s1, d0 according to EN 13501-1. The materials used in the valve blankets shall also meet the requirements of the current Building Regulations Part B regarding fire safety. 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 0.033W/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.
- 31.4.2.13 Water services pipework insulation thicknesses shall conform to BS 5422:2023 the tables below:

Insulation Thickness

Pipe Outer Diameter (mm)	Domestic Hot Water (Enhanced, 60°C)	Non-Domestic Hot Water (Enhanced, 60°C)	Mains/Cold Water (Condensation Control @ 0°C)
≤15	25 mm	30 mm	30 mm
≤21.3 / 22	25 mm	40 mm	30 mm
≤26.9 / 28	30 mm	40 mm	40 mm
≤33.7 / 35	30 mm	40 mm	40 mm
≤42.4 / 42	30 mm	40 mm	40 mm
≤48.3	30 mm	40 mm	40 mm
≤54 / 60.3	30 mm	50 mm	50 mm
≤76.1	35 mm	50 mm	50 mm
≤88.9	40 mm	50 mm	50 mm
≤114.3	40 mm	60 mm	60 mm

31.4.3 PVC Cladding System

- 31.4.3.1 All exposed insulated pipework, ductwork, and other mechanical services located within the building shall be finished with a protective PVC cladding system. This includes all insulated pipes, bends, T-pieces, fittings, flanges, and valves.
- 31.4.3.2 The cladding system shall be an economic coating system in accordance with DIN 4140, manufactured from a light grey, impact-resistant hard PVC foil. The material shall be physiologically harmless, odourless, and suitable for use in food processing plants.
- 31.4.3.3 The PVC material shall be unplasticised and manufactured without the use of silicone or heavy metals such as cadmium, lead, or mercury. It shall have a service temperature range of -20°C to +60°C.
- 31.4.3.4 The cladding system shall provide a complete range of pre-formed components, including but not limited to:
- 31.4.3.5 Bends: One-piece and two-piece (welded) 90° and 45° elbows to suit various pipe radii and insulation thicknesses.
- T-pieces: Prefabricated or flexible T-pieces for cladding branch pipes.
 - Fittings: End caps, rosettes, valve caps, and flange caps.
 - Sheet/Rolls: PVC foil for straight runs of pipework and ductwork.
- 31.4.3.6 All components shall be installed in strict accordance with the manufacturer's instructions to provide a neat, professional, and robust finish. Joints and seams shall be secured using colour-matched PVC rivets and/or PVC tape as recommended by the manufacturer.
- 31.4.3.7 The contractor shall provide a minimum of three colour options for the PVC cladding system for review and final selection by the Architect. The final selection shall be applied consistently across all specified services.
- 31.4.3.8 A full technical submittal for the proposed PVC cladding system, including product data sheets and colour samples, shall be submitted to the Engineer and Architect for approval prior to ordering any materials.

31.4.4 Fittings

- 31.4.4.1 All water fittings and associated jointing compounds shall be to the following Third-Party Approvals:
- WRAS Water Regulations Advisory Scheme
 - DIN - Deutsches Institut für Normung test certification
- 31.4.4.2 Pressure Rating
- 16mm to 63mm - PN 16 at 20°C
 - 75mm to 110mm - PN16 at 20°C
- 31.4.4.3 Seats and Seals
- Seats: PTFE material fitted with O-Ring compensators. Seals: Standard size O-Ring type for ease of replacement.
 - All ABS fittings shall be suitable for solvent with dimensions and tolerances in accordance with EN ISO 15493. All other requirements of this standard must

be fulfilled. All threaded connections shall have pipe threads in accordance with the requirements of ISO 7-1.

31.4.4.4 All valves shall be of the one manufacturer throughout the system. The contractor shall engage the manufacturer to determine all 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.

31.4.4.5 All water services valves and jointing compounds shall be WRAS approved.

31.4.5 Fittings

31.4.5.1 All isolating valves shall be WRAS approved. Ball valves, up to and including 50mm nominal diameter, shall be DR Brass, full bore, anti-blowout stem design, manufactured to BS EN 13547. Butterfly valves, 50mm and above, shall be ductile iron body with stainless steel disc, flanged type PN16, manufactured to BS EN 593. All valves shall operate from -10°C to 120°C, be Handwheel or Lockshield pattern, and clearly marked with manufacturer, material, pressure, size, and flow. Ball valves shall have sockets for bronze welding or approved compression unions (contractor to provide approval documentation). Extended stems shall be provided for all valves to ease operation and maintenance, especially in insulated or hard-to-access areas.

31.4.5.2 Ball Valves (Up to 50mm)

- All isolating ball valves up to 50mm shall be bronze body, full bore, anti-blowout stem design, manufactured to BS EN 13547.
- Body material: Bronze BS EN 1982 CC491K.
- Ball material: DZR Brass (1/2"-1"), Bronze (1 1/4"-2"), both chrome plated.
- Seats: PTFE.
- Stem: DZR Brass.
- Threaded ends to BS EN 10226-2 (ISO 7-1).
- Pressure rating: PN25.
- Temperature range: -10°C to 186°C.
- WRAS approved (up to 85°C).
- Kiwa approval.
- Marked with manufacturer, material, pressure, size, flow.
- Extended stems shall be provided on all isolation valves for ease of operation and maintenance, especially in insulated or hard-to-access areas.
- Contractor to provide documentation for compression unions and valve equivalency.
- Butterfly Valves (50mm and Above) - Potable Water (Replace 31.X with the appropriate section number)

31.4.5.3 Butterfly valves (50mm and above)

- All butterfly valves shall be WRAS approved and suitable for operation between -10°C and 80°C.
- Valves shall be lever operated, designed for flow regulation, and conform to BS EN 593 (design) and BS EN 558 (face-to-face dimensions).
- Valves shall be compatible with flanges to BS EN 1092-2 PN10/PN16 and ANSI B16.1 Class 125, and suitable for Level 3 C3 (Medium) corrosion environments.
- The valve body shall be ductile iron (ASTM A536 64-45-12) with a fully bonded epoxy coating, and the disc shall be aluminium bronze (C954 ASTM B148).
- The liner shall be WRAS-approved EPDM, rated for -10°C to 100°C (80°C for WRAS compliance).
- The shaft and taper pin shall be stainless steel type 410, with Buna-N O-rings and PTFE bushings.
- The lever shall be aluminium alloy with epoxy coating, incorporating an anti-blowout stem design and integrated notch plate. Valves shall be PN16/Class

125 rated, with shell and seat test pressures of 24 bar and 17.6 bar, respectively.

- Installation shall follow manufacturer's instructions, and each valve shall be clearly marked with manufacturer, material, pressure, size, and flow direction.
- Valves shall be suitable for Group 2 liquids as defined by the Pressure Equipment Directive 2014/68/EU."

- 31.4.5.4 All automatic air vents, designed to remove trapped air and simplify venting, shall confirm to BS EN 1074-4 and be WRAS approved for closed circuit use. The vents shall be of the D2004 series or equivalent, and constructed with: brass bodies (EN12165-CW617N for 1", EN 1982-CC754S for 3/8"-3/4"), brass covers (EN12165-CW617N), plastic components (POLYAMIDE PA6 GF30% plug, ACETAL piston/separating/lever, and float hooking mechanism), brass seats (EN 12164-CW614N), PTFE gaskets, EPDM PEROX O-rings, stainless steel springs (EN 10270-3-1.4310/AISI 302-EN 10270-3 NS), and polypropylene floats. Where fitted, isolation valves shall be brass (EN 12164-CW614N) with NBR O-rings. Vents shall feature a non-mechanically coupled polypropylene float, spring-loaded shutoff, 10 bar pressure rating, 0-110°C temperature rating, 7 bar maximum discharge pressure, EPDM seals, BSP parallel threads, and a 1/2" shut-off valve option (D2004 or equivalent). Installation shall follow manufacturer's instructions, and a 3-year minimum leakage guarantee is required.
- 31.4.5.5 All pressure gauges shall be of the vapour pressure type with a 100mm diameter dial, selected to suit the application with normal operating pressure near the midpoint of the range, and an accuracy of +/- 1% of the effective range. For potable water systems, gauges shall be WRAS approved, with wetted parts of WRAS-approved DR brass or 316L stainless steel, and a maximum working temperature of 85°C. Gauges shall withstand continuous operation at 75% of full scale, have an IP65 or higher rating, and be fitted with isolation valves. Test and calibration certificates from a recognised laboratory are required. Gauges shall be vertically mounted unless otherwise agreed, and manufacturers shall be consulted for pulsating pressures or shock. Liquid-filled gauges must have a safety release; gauges on hot liquids shall be protected by a syphon or approved means, and frost protection is required for gauges exposed to freezing conditions.
- 31.4.5.6 Check Valves (Up to 50mm). All check valves up to and including 50mm nominal diameter shall be WRAS approved, bronze (BS EN 1982 CC491K or equivalent) swing or lift type, manufactured in accordance with BS 5154 PN20. Check valves shall be temperature rated to operate from -10°C to 120°C. Valves shall be fitted with female sockets for bronze welding or approved compression type unions (contractor to provide documentation of approval). All valves shall be clearly marked with manufacturer's name, body material designation, pressure rating, size, and directional flow.
- 31.4.5.7 Check Valves (65mm and above). All check valves 65mm nominal diameter and above shall be WRAS approved, flanged cast iron swing type to PN16, manufactured in accordance with BS EN 12334. Check valves shall be temperature rated to operate from -10°C to 120°C. Swing check valves shall be installed in a horizontal position or, where this is not possible, in a vertical position with the hinge pin horizontal, ensuring the valve closes under zero-flow conditions. All valves shall be clearly marked with manufacturer's name, body material designation, pressure rating, size, and directional flow.

- 31.4.5.8 All valves within plant rooms and ceiling voids shall be supplied and installed with appropriately sized thermal insulation lagging jackets, suitable for the operating temperature and environment. The jackets shall be removable for maintenance access.
- 31.4.5.9 All Flow meters shall be provided free issue by the BMS controls contractor and installed by the mechanical contractor. Flow meters shall be of a vane wheel type with a read contact, providing pulse output with M-BUS communication. Flow meters shall be MID approved. The mechanical contractor shall ensure that the flow meters are installed in accordance with the BMS controls contractor's instructions and manufacturer guidelines.
- 31.4.5.10 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. All materials in contact with potable water must be WRAS approved.
- 31.4.6 Thermostatic mixing valves
- 31.4.6.1 Thermostatic mixing valves (TMVs) shall be provided to all wash hand basins, sinks, and showers.
- 31.4.6.2 TMVs shall be TMV3 certified and, where applicable, TMV2 certified, and shall be WRAS approved as a complete assembly, complying with EN 1111 and EN 1287 standards. Shower valves shall comply with the TMV3 scheme and have WRAS approval, carrying BS 7942 and ETC/200/1202 certification.
- 31.4.6.3 TMVs shall be provided with a 5-year guarantee.
- 31.4.6.4 TMVs shall be provided with two integral service valves, check valves, and serviceable fine mesh strainers.
- 31.4.6.5 TMVs shall have swivel inlet connections with flat-faced unions and compression fittings and shall incorporate a flow regulator with a minimum flow rate of 8 Litres per minute.
- 31.4.6.6 The thermostatic cartridge shall maintain mixed flow temperature to +/- 1°C up to an inlet water pressure differential of 10:1. The thermostatic temperature setting head shall be tamper-proof and limited to a maximum flow temperature of 41°C.
- 31.4.6.7 The mixed flow shall shut off automatically in the event of hot or cold supply failure.
- 31.4.6.8 The range of maintained water supply pressures shall be 0.2-5 bar, with a maximum static pressure of 10 bar.
- 31.4.6.9 To comply with BS EN 806, all pipework shall be flushed after installation, renewal, or repair. A flushing kit, compatible with the specified TMVs, shall be provided to allow thorough flushing at full bore without debris entering the TMV, check valves, or strainers.
- 31.4.6.10 Periodic high-velocity flushing is recommended to remove biofilm from internal pipe surfaces.
- 31.4.6.11 The mixed water temperature setting at the factory shall be 41°C, with a range of temperature adjustment of 35-50°C, and a range of hot water supply temperature of 55-65°C

31.4.7 Thermal Balancing Valve

- 31.4.7.1 Automatic thermal balancing valves shall be installed in the Domestic Hot Water (DHW) secondary circulation system as indicated on the drawings.
- 31.4.7.2 Valves shall incorporate adjustable temperature control for hydronic balancing in circulation pipes according to DVGW Code of Practice W551/W553.
- 31.4.7.3 Valves shall be WRAS approved for potable water systems and manufactured from bronze to BS EN 1982 CC491K.
- 31.4.7.4 All wetted parts shall be free of brass.
- 31.4.7.5 Valves shall be designed for hydronic balancing and automatic thermostatic regulation of DHW return systems, incorporating automatic pasteurization functionality.
- 31.4.7.6 Valves shall have an integral thermometer, drain point with hose union connection, insulation lagging box, and a double regulating valve (DRV) for isolation.
- 31.4.7.7 Valves shall incorporate press connection ends.
- 31.4.7.8 Valves shall have an adjustable temperature control range of 40°C to 65°C, with a recommended control range of 55°C to 60°C. Valves shall be factory pre-set to control the DHW secondary return water temperature at 58°C, with a control accuracy of +/- 1K.
- 31.4.7.9 The temperature and volume flow settings shall be capable of being lead sealed to prevent unintentional adjustment.
- 31.4.7.10 Valves shall automatically adjust flow to maintain the set temperature, preventing dead legs, and automatically initiate pasteurization when the stored hot water temperature is elevated.
- 31.4.7.11 During pasteurization, valves shall increase flow when the water temperature reaches 6°K above set point and return to thermostatic regulation mode at 73°C. Valves shall allow for thermal disinfection above 70°C without manual adjustment, be capable of manual isolation, and have a valve seat cleanable without draining.
- 31.4.7.12 Valves shall incorporate a fixed residual volume flow, automatically detect thermal disinfection, and incorporate a regulating unit with reproducible presetting, that is capable of limiting and shutting off the max. volume flow.
- 31.4.7.13 A temperature sensor must be capable of being retrofitted to the valve.
- 31.4.7.14 Installation shall be in accordance with the manufacturer's instructions, with a lockshield cap and sealing wire to prevent unwanted adjustment.
- 31.4.7.15 The contractor shall ensure the system is fully balanced in terms of flow and temperature. The valves supplied must be of a design and construction that is equivalent to the previously referenced thermal balancing valve.
- 31.4.7.16 The contractor must provide documentation proving the valves supplied are equivalent. This documentation must include, but is not limited to, material certificates, WRAS certificates, and manufacturer's datasheet.

31.5 Construction Products Regulations

- 31.5.1 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.
- 31.5.2 All products where applicable must comply with relevant Harmonised European Standards (hENs)
- 31.5.3 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.
- 31.5.4 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.
- 31.5.5 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.
- 31.5.6 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.
- 31.5.7 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.
- 31.5.8 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.

31.6 Samples & Technical Submittals

- 31.6.1 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.
- 31.6.2 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.
- 31.6.3 The contractor shall be responsible for determining quantities from IN2 Engineering Design Partnership drawings and specifications.
- 31.6.4 The contractor shall liaise with the various specialist suppliers to ensure that all necessary fixings kits, supports, connections, etc. are included.
- 31.6.5 The contractor shall refer to IN2 Engineering Mechanical Specification, Section M00 General specification.
- 31.6.6 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.

31.7 Approved Manufacturers and Vendors

- 31.7.1 The following manufacturers may be considered for the provision of the pipework fittings and instrumentation.
- 31.7.2 Valves and Gauges.
- Isolating valves, Crane or equivalent
 - Check valves, Crane or equivalent
- 31.7.3 Automatic Air Vents Spirotech or equivalent
- 31.7.4 Temperature Gauges, Boss or equivalent
- 31.7.5 Pressure Gauges, Boss or equivalent
- Thermostatic Mixing Valves, Horne or equivalent
 - Thermostatic Hot Water return balancing valves, "Aquastrum T Plus", Oventrop or equivalent
- 31.7.6 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.

31.8 Installation

31.8.1 The arrangement and size of all water services pipework and fittings as required shall be as shown as indicated on IN2 Engineering Design Partnership M30 series drawings and where necessary, as agreed with the Engineers on site.

31.8.2 Pipework

31.8.2.1 All copper 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	1.8	1.2
22	2.4	1.8
28	2.4	2.4
35	3.0	3.0
42	3.0	3.0
54	3.6	4.0

- 31.8.2.2 All 15mm and 22mm diameter copper pipework installed at low level shall be supported at 1200mm centres, with all other size supported at 1800mm centres.
- 31.8.2.3 All supports for copper pipework shall be of polished brass were exposed and rough finish elsewhere. Ferrous supports will not be permitted on non-ferrous pipes.
- 31.8.2.4 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.
- 31.8.2.5 Brackets or supports shall be set out so that they do not obstruct the access to valves, flanges or other fittings requiring maintenance.
- 31.8.2.6 All thermostatically mixed water supplies shall have a **maximum pipe length of 1m.**
- 31.8.2.7 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.
- 31.8.2.8 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. Where pipes pass through visible walls, floors and ceilings, they shall chromium plated.
- 31.8.2.9 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.
- 31.8.2.10 Wherever possible, advantage is to be taken of changes in direction to the hot water services 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.
- 31.8.2.11 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.
- 31.8.2.12 The mechanical contractor shall include for all necessary attendances with the Local Authority during installation of the new water service and act as liaison between the Main Contractor and the Local Authority.
- 31.8.2.13 The mechanical contractor shall ensure that hot and cold-water supply pressures are balanced at all outlets.
- 31.8.2.14 All site water 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 900mm. Surface made good to Architects detail.
- 31.8.2.15 Water Treatment
- 31.8.2.16 All Water Treatment plant shall be installed as per manufacturer's recommendations.
- 31.8.2.17 All Water Treatment plant shall be commissioned by supplier/manufacturer.

31.8.3 Fittings

- 31.8.3.1 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.
- 31.8.3.2 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.
- 31.8.3.3 Drain valves shall be installed at all low un-drainable parts of the system.
- 31.8.3.4 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.
- 31.8.3.5 Contractor to engage automatic thermal balancing valve 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.
- 31.8.3.6 Contractor to engage automatic thermal balancing valve manufacturer to carry out 1No. site review during installation of valves to ensure manufacturers requirements/standards are being met.
- 31.8.3.7 Contractor to engage automatic thermal balancing valve manufacturer to carry out 1No. site review during commissioning of valves to ensure system is being properly commissioned in accordance with manufacturers recommendations.
- 31.8.3.8 All flow meters to be provided free from BMS controls contractor and installed by mechanical contractor.
- 31.8.3.9 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.
- 31.8.3.10 The mechanical contractor shall include for final connections to all sanitary fittings.
- 31.8.3.11 Temperature and pressure gauges shall be installed in a visible and accessible position.

31.8.4 Pipework Insulation

- 31.8.4.1 Pipework shall remain uninsulated until satisfactory completion of all hydraulic tests.
- 31.8.4.2 The brackets and roller support 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.
- 31.8.4.3 All valves and accessories within all plant room areas shall be insulated to the same thickness specified for the pipeline.
- 31.8.4.4 All valves where applicable shall be supplied with stem extension pieces to allow insulation to pass through the valve body and ease of future maintenance.

- 31.8.4.5 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.

31.9 Testing & Commissioning

- 31.9.1 This entire section shall be executed in accordance with the principles and procedures outlined in CIBSE Commissioning Code W and BSRIA Application Guide BG2/2010. The contractor is responsible for providing all necessary calibrated instrumentation and competent personnel to carry out the works. A detailed commissioning programme and method statements must be submitted for review prior to commencement.
- 31.9.2 All water services pipework shall be tested to 1,000 kPa and held drop tight 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.
- 31.9.3 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.
- 31.9.4 All hot and cold-water outlets shall be tested and verified for adequate water pressure prior to handover.
- 31.9.5 All hot water outlets shall be tested to ensure availability of correct water temperature and each hot water return leg shall be proven prior to handover
- 31.9.6 Seasonal Commissioning and Handover
- 31.9.6.1 The specialist contractor shall carry out seasonal commissioning to verify system performance under varying load conditions. This will involve return visits to site during the first 12 months of operation to check and fine-tune system controls and performance during both heating and cooling seasons. A comprehensive commissioning report, including all test records, calibration certificates, and performance data, shall be submitted as part of the building logbook for final handover.

31.10 Labelling

31.10.1 Pipework Identification:

- 31.10.1.1 All pipework shall be identified by means of self-adhesive coloured bands and directional flow arrows.
- 31.10.1.2 Colour coding and identification shall be in accordance with BS 1710:2014 (or the latest relevant revision) and any project-specific colour coding schedules provided.
- 31.10.1.3 Band widths and spacing shall conform to BS 1710:2014, taking into account pipe diameter and visibility requirements.
- 31.10.1.4 Directional flow arrows shall be clearly visible and placed adjacent to the coloured bands, indicating the direction of fluid flow.
- 31.10.1.5 In addition to colour bands, pipes shall be labelled with their service description (e.g., "LPHW Return," "Domestic Cold Water") using durable, UV-resistant self-adhesive labels. Label text shall be clearly legible and of an appropriate size for the pipe diameter and viewing distance.
- 31.10.1.6 Labels shall be placed at regular intervals along the pipework (maximum distance of 3 meters), at all changes of direction, at penetrations through walls or floors, and adjacent to valves and other fittings.
- 31.10.1.7 All pipe hangers, supports, and anchor brackets, etc., which do not have a galvanized or other approved protective coating, shall be prepared, primed and painted with two coats of paint in accordance with the project painting specification section [Insert Specific Section Reference Here].
- 31.10.1.8 For insulated pipework, labels and bands shall be placed on the outer surface of the insulation.

31.10.2 Valve and Fitting Identification:

- 31.10.2.1 All valves, fittings, and equipment (including pumps, strainers, pressure gauges, etc.) shall be individually numbered and identified using durable, weatherproof traffolyte or similar rigid plastic labels (referred to as "traffo labels").
- 31.10.2.2 Labels shall be securely fixed to the valve, fitting, or equipment using stainless steel wire, cable ties, or other approved methods, ensuring they are clearly visible and cannot be easily removed.
- 31.10.2.3 Each label shall include a unique identification number and a brief description of the valve, fitting, or equipment function.
- 31.10.2.4 The contractor shall provide detailed plant room labelling charts for each plant room, clearly identifying each valve, fitting, and piece of equipment by its identification number and description. These charts shall be laminated or otherwise protected from damage and displayed prominently within each plant room.
- 31.10.2.5 The plant room labelling charts shall include a schematic diagram of the pipework layout, showing the location of each labelled item.
- 31.10.2.6 All Labels shall be UV stable, and chemical resistant.
- 31.10.2.7 All equipment that requires electrical isolation shall be labelled with its corresponding electrical panel and breaker number.

31.10.3 Equipment Identification:

31.10.3.1 All major plant equipment (pumps, heat pumps, expansion vessels, air handling units, etc.) shall be provided with durable, weatherproof nameplates indicating the equipment manufacturer, model number, serial number, and other relevant information.

31.10.3.2 Nameplates shall be securely fixed to the equipment in a visible location.

31.10.3.3 All electrical panels shall be labelled with their corresponding system or area served.

31.10.3.4 All control panels shall have a laminated schematic of the controlled system placed inside the panel.

31.10.4 General Requirements:

31.10.4.1 All labelling shall be carried out in a neat and professional manner.

31.10.4.2 The contractor shall submit a labelling schedule for approval prior to commencing work.

31.10.4.3 The contractor shall be responsible for maintaining the labelling throughout the duration of the project and for replacing any damaged or missing labels.

31.10.4.4 All labels shall be in the English Language, unless otherwise specified.

31.10.4.5 All labels shall be easily readable from a normal working position.

31.10.4.6 All labels shall be of high quality and designed to last the intended life of the installation.

31.11 Documentation

- 31.11.1 Prior to handover, the Contractor shall provide a comprehensive set of testing and commissioning documentation, including:
- Pressure test certificates.
 - Flushing and disinfection records.
 - Flow and pressure verification reports.
 - Temperature verification reports.
 - TMV test certificates.
 - System balancing report.
 - As-built drawings of the water services system.
 - Operating and maintenance manuals for all equipment.
- 31.11.2 Upon project completion the contractor shall provide complete Operation and Maintenance instructions with "As installed" drawings.
- 31.11.3 The contractor shall provide the following documentation for all water services installations.
- Complete pipework pressure test results indicating:
 - Date of test
 - Test pressure.
 - Duration of test
 - Signatures of the contractor's witness and engineer's representative witness.

31.12 Cleaning, Flushing, and Disinfection

- 31.12.1 The entire water installation (Mains, Cold, and Hot Water Services) shall be thoroughly flushed, cleaned, and disinfected in accordance with BS 8558:2015 and BS EN 806-4, and the requirements of HSE L8 (ACOP) and HSG274 Part 2.
- 31.12.2 Prior to disinfection, all systems shall be flushed with potable water to achieve a minimum velocity of 1.5 m/s to ensure the removal of construction debris, flux residues, and scale. All strainers shall be cleaned after the initial flush.
- 31.12.3 The system shall be filled with a solution containing a free chlorine residual of 50 mg/l (ppm) for a contact period of 1 hour, or 20 mg/l (ppm) for 2 hours.
- 31.12.4 The chlorine shall be introduced at the point of entry and drawn through to every single outlet (taps, showers, TMVs, cisterns).
- 31.12.5 The concentration shall be verified at the furthest outlet using calibrated digital meters.
- 31.12.6 After the contact period, the chlorinated water shall be neutralised using an approved agent before being discharged to the foul sewer. It must not be discharged to the surface water.
- 31.12.7 Following final flushing with potable water, samples shall be taken from the incoming mains, the storage tank, and the furthest outlets.
- 31.12.8 Samples must be analysed by an INAB/UKAS accredited laboratory.
- 31.12.9 Testing parameters must include: TVC @ 22°C and 37°C, E. Coli, Coliforms, and Pseudomonas Aeruginosa.
- 31.12.10 The system shall not be considered "Handed Over" until a Clear Water Certificate is issued.
- 31.12.11 The Mechanical Contractor shall include within their tender sum for a mandatory 4-week post-handover flushing and monitoring period. This period commences only after the successful completion of the initial disinfection and the issuance of a "Clear Water Certificate."
- 31.12.12 During this 4-week period, the Contractor shall implement a twice-weekly flushing regime (minimum 2 minutes per outlet) of all hot and cold-water outlets, including TMVs, showers, and plant room wash-down points, to prevent water stagnation.
- 31.12.13 The Contractor shall maintain a dedicated Water Safety Logbook on-site.
- 31.12.14 The logbook shall record: Date, time, outlet ID, flushing duration, and water temperature (both flow and return/ambient).
- 31.12.15 Any outlet consistently exceeding 20°C (Cold) or failing to reach 50°C (Hot) within one minute shall be reported to the Engineer immediately.
- 31.12.16 If building occupancy is delayed beyond 7 days following the initial disinfection, the Contractor remains solely responsible for the microbiological integrity of the system.
- 31.12.17 If the Contractor fails to provide evidence of consistent flushing (via the Logbook) or if the 4-week period expires and occupancy has still not occurred, the Engineer may instruct a full system re-disinfection in accordance with BS 8558:2015. This re-disinfection and subsequent laboratory testing shall be carried out at the Contractor's sole expense without any variation to the contract sum.

- 31.12.18 Formal handover of the water services system responsibility to the Client's facilities management team shall only occur upon the successful completion of the 4-week flushing period and the formal signing-off of the completed Water Safety Logbook.

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40.2 Outline Description

- 40.2.1 The Contractor shall be responsible for the supply, installation, and testing of the complete above ground soils and wastes systems as detailed on IN2 Engineering Design Partnership specification and drawings.
- 40.2.2 The following is a summary of the Mechanical Services scope of works:
- Horizontal and vertical waste pipework.
 - Mounting Acoustic Lined brackets / supports
 - Final Connections of all sanitaryware to vertical soils and waste stacks.
 - Installation of rodding eyes.
 - Pipework Acoustic insulation
 - Waterless Traps to Air Conditioning and Ventilation Equipment.
 - Condensation Traps to vertical ductwork terminating to external i.e. roof.
 - Testing and system flushing during construction.
 - Labelling and tagging of services.
 - Handover documentation, to include photographic evidence of pressure testing of the soils and waste pipework installation throughout.
- 40.2.3 The Main Contractor shall be responsible for the supply, installation, and testing of the complete below ground soils and wastes systems as detailed on civil engineers' drawings.
- 40.2.4 The Contractor shall be responsible for the Design, Selection and installation of the complete support & Bracketry systems (inc Anti-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.
- 40.2.5 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.
- 40.2.6 The Contractor shall carefully read the notes on the drawings and include for all associated costs in his tender.
- 40.2.7 The Main Contractor shall carefully read the notes on the drawings and include for all associated costs in his tender.
- 40.2.8 All above ground systems shall be connected to discharge to builders' upstands at ground level.
- 40.2.9 The supply and installation of all sanitary fittings shall be the responsibility of the Main Contractor. The Contractor shall be responsible solely for all final connections of sanitaryware to vertical soils and waste stacks.

40.3 Standards

40.3.1 The soil and waste sanitary systems shall fit in accordance with:

BS EN 12056: Gravity drainage systems inside buildings
2000: Pt 1-5:

Building Regulations TGD
Part H Drainage and Wastewater Disposal (2016)

BS EN 1329-1:2021 Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Unplasticized poly(vinyl chloride) (PVC-U). Specifications for pipes, fittings and the system.

BS EN 1519-1:2023 Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Polyethylene (PE). Specifications for pipes, fittings and the system

BS 476 20:1987 Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles)

BS 5391-1:2006 Acrylonitrile-butadiene-styrene (ABS) pressure pipe. Specification

BS 5392-1:2006 Acrylonitrile-butadiene-styrene (ABS) fittings for use with ABS pressure pipe. Specification

BS EN 1254-2:2021 Copper and copper alloys. Plumbing fittings. Fittings with compression ends for use with copper tubes

40.4 Equipment

- 40.4.1 All above ground drainage pipework shall be uPVC pipework to IS EN 1329-1:2021 standard. (Unless otherwise noted on IN2 Engineering Design Partnership drawings).
- 40.4.2 All uPVC internal pipework shall be either integral acoustically rated with 25mm foil backed insulation or acoustically insulated to suit pipework.
- 40.4.3 All uPVC internal pipework shall be solvent glued pipework.
- 40.4.4 Main vertical soil pipes shall be Ø110mm or as indicated on drawings, uPVC pipework and the respective main vent pipes shall be Ø110mm (or as indicated on drawings) diameter uPVC.
- 40.4.5 Bottle traps with 75mm seal shall be provided on the outlets of all sanitary fittings connected to the waste pipes. Concealed bottle traps shall be finished uPVC. All exposed bottle traps shall be finished in chrome plated copper.
- 40.4.6 The Main Contractor's fireproofing specialist shall include for the design, supply, installation and certification of all fire collars / wraps to all soils and wastes pipework penetrations through fire rated shafts and walls.
- 40.4.7 All cold-water storage tank and WC overflow pipes to be installed with Legionella arrestors.
- 40.4.8 The Contractor shall include for the supply and installation of all necessary collars/fittings required for interconnection of uPVC & HDPE pipework.
- 40.4.9 All ground floor outlets shall have a dedicated builder's upstand at floor level. The soil vent pipes only serving upper floors and venting purposes. No waste pipework shall be routed via electrical switch rooms, comms rooms or electrical distribution board areas. The end of all soil lines shall be vented to above roof level.
- 40.4.10 All AC units shall be provided with a separate horizontal discharge complete with a self-sealing waste valve.
- 40.4.11 A self-sealing valve shall be provided on all showers and wash hand basins prior to connecting to the soils stack in order to avoid penetration of odours from other systems due to low usage.
- 40.4.12 The mechanical contractor shall allow for fire collars where pipework passes through all fire barriers. Contractor to refer to the fire cert drawings.
- 40.4.13 All vent pipes shall terminate at a minimum height above roof level of 450mm. Soil vent cowls shall not be basket type.
- 40.4.14 In addition to the access points shown on the IN2 drawings, the contractor shall allow for access points in drainage pipelines shall be in the following positions: -
- 40.4.15 At the end of all exposed waste pipes.
- 40.4.16 At all changes in direction
- 40.4.17 At right angle bends.
- 40.4.18 At the foot of all soil stacks
- 40.4.19 At any other location deemed necessary to allow complete rodding of the system

40.5 Construction Products Regulations

- 40.5.1 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.
- 40.5.2 All products where applicable must comply with relevant Harmonised European Standards (hENs)
- 40.5.3 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.
- 40.5.4 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.
- 40.5.5 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.
- 40.5.6 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.
- 40.5.7 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.
- 40.5.8 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.

40.6 Samples & Technical Submittals

- 40.6.1 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.
- 40.6.2 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.
- 40.6.3 The contractor shall be responsible for determining quantities from IN2 Engineering Design Partnership drawings and specifications.
- 40.6.4 The contractor shall liaise with the various specialist suppliers to ensure that all necessary fixings kits, supports, connections, etc. are included.
- 40.6.5 The contractor shall refer to IN2 Engineering Mechanical Specification, Section M00 General Specification.
- 40.6.6 All technical submittals shall be issued in the following format.
- 40.6.7 A full index of items, date & revision number of submittal shall be included on the submittal title page.
- 40.6.8 All manufacturers / Suppliers' schedules shall refer to IN2 item references.
- 40.6.9 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:
 - 40.6.10 "Manufacturer / Supplier Initial" & "Compliant" or "Non-Compliant".
 - 40.6.11 Should a line item prove non-compliant to spec, the manufacturer / supplier shall include details of proposed alternative.
 - 40.6.12 Expected lead-in times shall be included for all items.
 - 40.6.13 Where applicable contractor shall propose date for reviewing / approving samples on site.
 - 40.6.14 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.

40.7 Approved Manufacturers and Vendors

- 40.7.1 The following manufacturers may be considered for the provision of the waste pipework and all components.
- 40.7.2 uPVC solvent welded pipework shall be by Wavin AS+ or equivalent
- 40.7.3 Acoustic wrap shall be by Muftilag, Acoustiduct, Techpipe or equivalent
- 40.7.4 Alternative products / systems will be considered if the contractor can demonstrate that the proposed alternative is equivalent to that specified in all 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.

40.8 Installation

- 40.8.1 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.
- 40.8.2 Soils and wastes pipework shall be installed strictly in accordance with the manufacturer's instructions with particular reference to pipe fixing, fixing centres and provision for expansion.
- 40.8.3 The contractor shall include for final connections to all sanitary fittings.
- 40.8.4 Cleaning eyes and access doors for maintenance shall be provided at every change in direction and at each floor level.
- 40.8.5 Tee connection with cleaning door shall be provided at each W.C. connection to the main soil pipe.
- 40.8.6 All vent pipes to atmosphere at roof level shall be complete with weathering aprons and cowls.
- 40.8.7 Final connections to wash hand basins shall be Ø32mm with connections to the soil pipe in Ø50mm.
- 40.8.8 Final connections to sinks shall be Ø40mm with connections to the soil pipe in Ø50mm.
- 40.8.9 Final connections to water closets shall be Ø110mm.
- 40.8.10 Swept entry fittings shall be used at the connection between Ø32mm waste from WHB's and the Ø50mm common waste.
- 40.8.11 Anti-siphon traps shall be used on all WHB's, urinals and sinks.
- 40.8.12 Waterless Traps to be provided to mechanical heat recovery unit, air conditioning units condensation, and safety discharge pipework.
- 40.8.13 Each W.C shall have individual Ø22mm diameter overflow to discharge to outside of bend.
- 40.8.14 Fire collars/wraps shall be supplied and installed on all pipework passing through fire compartments by the Main Contractor's appointed fireproofing specialist. The sleeve construction is to be of metal, lined with a graphite-based intumescent material. The one-piece shell is to be wrapped around the pipe and held in place by a locking tab. One end of the body is to have tabs with holes for fixing to the surface. Fixing instructions are to be as per manufacturer's recommendations.
- 40.8.15 All uPVC pipework joints shall be solvent welded.
- 40.8.16 Should expansion joints be required a seal ring joint shall be used.
- 40.8.17 Expansion joints must be provided at a maximum of 5m intervals and / or changes in direction more than a meter apart unless clipping are positioned to allow movement. Intermediate sliding supports must be provided in accordance with the manufacturer's guidelines.

- 40.8.18 All acoustically insulated uPVC pipework (as indicated on drawings) shall be installed complete with acoustically insulated brackets of the same manufacturers range.
- 40.8.19 A branch pipe shall not discharge into a stack in a way which could cause crossflow into any other branch pipe. Where a branch enters a stack, it creates a zone on the opposite wall of the stack where no connections may be made.
- Where the branch pipe diameter is less than 65mm, the no-connection zone is 110mm deep on a 110mm stack and 250mm deep on a 160mm stack, measured from the centre line of the incoming branch.
 - Where the branch pipe diameter is 65mm or greater, the no-connection zone is 200mm deep, irrespective of stack diameter.
 - Connections whose centre lines are on the boundary of the zones are acceptable.
- 40.8.20 Branch Pipe Lengths, Gradients, and Ventilation:
- Branch pipes shall be installed with a gradient between 18mm/m and 90mm/m (1 to 5 degrees) as per Building Regulations Technical Guidance Document Part H Drainage and Waste Water Disposal.
 - Separate ventilation of branch pipes is required if the length and slope of the branch exceeds the following dimensions. An anti-syphon trap or branch ventilating pipe shall be fitted.
 - 32mm pipe: 1.7 metres maximum length.
 - 40mm pipe: 3.0 metres maximum length.
 - 50mm pipe: 4.0 metres maximum length.
 - A maximum of 8 WCs may be connected to a single unventilated Ø110mm soil branch, with a maximum length of 15m.
- 40.8.21 Stack Base Connections:
- The distance between the centreline of the lowest branch connection to the discharge stack and the invert of the bend at the foot of the stack shall be:
 - Buildings up to 3 storeys: 450mm minimum.
 - Buildings up to 5 storeys: 750mm minimum.
 - Buildings over 5 storeys: Ground floor connections shall discharge direct to drain or into their own stack.
 - Buildings over 20 storeys: Ground and first floor connections shall discharge into their own stack.
 - The minimum radius of the bend at the base of the stack shall be 200mm, or composed of 2 No. 45-degree bends.
- 40.8.22 Thermal Movement and Working Temperatures:
- Adequate allowance for thermal movement must be made. An expansion gap of 10mm shall be created at each expansion joint.
 - The system shall be suitable for continuous flow of liquids with a maximum temperature of 76°C, and intermittent discharges of up to 100°C for less than 2 minutes.

- The system must be resistant to chemicals commonly discharged to public sewers. The contractor must verify chemical compatibility with the seal manufacturer.

40.9 Testing & Commissioning

- 40.9.1 Above Ground Drainage
- 40.9.2 Contractor shall include for all soils and wastes risers to be air tested to 38mm water gauge and carryout a CCTV inspection for the entire above ground soils and waste pipework. CCTV inspection shall be included within the O&M Manuals.
- 40.9.3 All soils & waste services pipework shall be tested to 38mm water gauge and held airtight at this pressure for a duration of 3 minutes. During this time every trap should maintain a water seal of at least 25 mm. The tests shall be only considered valid if witnessed by the Engineer or Client representative and certified accordingly.
- 40.9.4 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.
- 40.9.5 All sanitary fittings shall be tested and verified for adequate wastewater flow and soils vent air flow prior to handover.
- 40.9.6 All work which will be concealed shall be tested before it is finally enclosed.
- 40.9.7 Air Test Procedure:
- The water seals of all sanitary appliances shall be fully charged. Test plugs or bags shall be inserted into the open ends of the pipework to be tested. A small quantity of water shall be added to the base of the stack to cover the lowest plug or bag to ensure a satisfactory seal. One of the remaining test plugs shall be fitted with a tee piece connected via flexible tube to a manometer.
 - Air shall be pumped into the system until a pressure of 38mm water gauge is obtained. The air inlet cock shall then be closed. The pressure in the system must remain constant for a period of not less than 3 minutes.
 - During this time, every trap must maintain a water seal of at least 25 mm. The tests shall only be considered valid if witnessed by the Engineer or Client representative and certified accordingly.
- 40.9.8 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.
- 40.9.9 All sanitary fittings shall be tested and verified for adequate wastewater flow and soils vent air flow prior to handover.
- 40.9.10 Below Ground Drainage
- 40.9.11 The main contractor shall be responsible for testing all below ground drainage to current standards and industry best practice.

40.10 Labelling

- 40.10.1 All pipework shall be identified by means of self-adhesive coloured bands. The identification shall be in accordance with BS 1710: 2014. All pipe hangers, supports and anchor brackets, etc. which do not have a galvanised or other protective coating, shall be painted with one coat of paint.



- 40.10.2 Colour coding shall be provided as follows:
- At 8m intervals on straight runs.
 - At all changes of direction.
 - Within 300mm of all valves.
 - Within 300mm of all equipment items.
 - At all junction points and branches (unless the end of branch is visible from the junction).
 - On all lines passing through walls and floors where lines are accessible and not visible from an identified main.

40.11 Documentation

- 40.11.1 Upon project completion the contractor shall provide complete Operation and Maintenance instructions with "As installed" drawings.
- 40.11.2 The contractor shall provide the following documentation for all soils and waste system installations.
- Complete pipework pressure test results indicating:
 - Date of test
 - Test pressure.
 - Duration of test
 - Signatures of the contractors witness and engineers' representative witness.

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70.1 Outline Description

70.1.1 General Scope of Work

- 70.1.1.1 The Contractor shall integrate new mechanical plant and controls into a new BMS outstation and the integrate / network into the existing Building Management system and provide a complete, turnkey Building Management System (BMS) and Control System installation. This includes all hardware, software, networking, and incidental equipment required to implement the scheme in its entirety, as detailed in the contract documents and to the satisfaction of the Engineer. The Contractor shall be responsible for all additional equipment incidental to specific control system requirements which may not be referenced within the specification or described on contract drawings.

70.1.2 System Intent

- 70.1.2.1 The primary objectives of the BMS are to provide centralised monitoring and control of HVAC and other critical plant, enhance energy efficiency, ensure system reliability, and maintain high levels of occupant comfort. The system shall integrate all building services into a single platform with a unified database and graphical user interface.

70.1.3 Contractor & Specialist Responsibilities

- 70.1.3.1 The Contractor shall engage a single, qualified BMS Specialist (Experience with TREND systems) to manage and execute all aspects of the work. The Contractor retains ultimate responsibility for co-ordination, delivery, storage, installation, quality control, testing, commissioning, and handover of the complete system.
- 70.1.3.2 The Contractor shall include for the complete Building Management System (BMS) and Control system 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.
- 70.1.3.3 The Contractor shall engage a specialist BMS 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.
- 70.1.3.4 The contractor shall have in place, the appropriate suitably qualified, experienced Building Management Systems and Contract Management senior personnel to manage and implement the BMS and HVAC controls installations. Details and relevant experience of qualified BMS Personnel & Management team shall be submitted as part of the Contractors technical proposals. The Contractors personnel must be trained, competent BMS Commissioning and Maintenance staff, with senior trade's qualifications, who have a thorough understanding of Commercial, mechanical and HVAC systems. It is essential that the Contractors personnel are familiar with all legislative requirement's relating to control of mechanical services / HVAC systems and have a thorough understanding of energy efficient operating strategies.
- 70.1.3.5 The Contractor shall employ a BMS specialist with extensive experience commercial settings and with specific understanding of relevant requirements to carry out the programming, commissioning, and setting to work of the existing Trend BMS system.

- 70.1.3.6 All installations and commissioning shall be in full accordance with the OEM manufacturer's recommendations, industry best practice BSRIA BMS Commissioning, Improving System Performance Guides, CIBSE Commissioning Codes, CIBSE Guides.
- 70.1.3.7 The BMS shall provide monitoring and control of HVAC installations, along with monitoring of critical plant and systems. The BMS shall incorporate Energy Management and metering of all primary energy users, with metering of electricity, and water consumption to be incorporated.
- 70.1.3.8 The BMS shall incorporate Motor Control Centre (MCC) panels, controls outstations and shall utilize programmable Direct Digital Control controllers, input/output units, sensors and actuators. The system shall also incorporate all Human Machine Interfaces (HMI) and Graphical User Interface, to provide a complete control and monitoring system.
- 70.1.3.9 The system must be "open protocol" with components and devices being freely available from a minimum of 3 authorised OEM supported vendors, who operate and provide installations, technical support and full aftercare servicing and maintenance within Ireland. "Closed" protocol systems, or systems offered by a single vendor will not be accepted. The Contractor shall within his tender submission state the details of systems proposed and as offered to include details of the BMS specialists.
- 70.1.3.10 The Contractor shall attend a BMS technical submittal review meeting with the Engineer, and the MEP Coordinator. This meeting shall follow the submission by the Contractor of detailed technical proposals that fully outline how the Contractor will fully implement the works requirements.
- 70.1.3.11 BMS controllers or device designed for controlling and monitoring the HVAC system and other small systems and integrate all other systems through dedicated networking protocols like BACnet, Modbus etc.
- 70.1.3.12 The Contractor shall be responsible for the installation and commissioning of a BMS network topology, to include network switches, routers and all necessary components. The operation of the BMS shall not rely on client ICT networks or components of the clients ICT network.
- 70.1.3.13 Each of the proposed BMS outstations /MCC's shall be provided with an RJ45 network connection to enable LAN and WLAN access by authorised users to the BMS System.
- 70.1.3.14 The system shall be configured to operate on a dedicated IP BMS network and on selected PC Terminals. In addition, it shall be configured to enable connection for third party monitoring or remote log-in connection.
- 70.1.3.15 The Contractor shall review the scheme design during the tender period and shall include all allowances as may be deemed necessary to complete the installations to the scheme design intent.
- 70.1.3.16 The Contractor shall carefully read the notes on all mechanical and electrical drawings and schematics and include for all associated HVAC controls and BMS costs in the submitted tender. The Contractor shall also refer to all mechanical and electrical specifications.
- 70.1.3.17 The Contractor shall be responsible for all handling, storing, transportation to site, testing and commissioning and setting to work. The BMS specialists shall be fully responsible to the Mechanical Specialists.

- 70.1.3.18 The BMS specialists shall be responsible for co-ordination between mechanical and electrical specialists with respect to all BMS system requirements and to ensure the correct and optimal positioning and fitting of control system devices.
- 70.1.3.19 Energy efficiency, systems reliability and high levels of occupant comfort are key functions that must be delivered through the effective configuration and commissioning of the BMS systems. The BMS specialists shall ensure control strategies are developed to satisfy the functional requirements, maximising energy efficiency and occupant comfort. The commissioning plan to be developed by the Contractor shall clearly demonstrate a fully co-ordinated approach to HVAC and BMS systems commissioning.
- 70.1.3.20 The Contractor shall provide a complete BMS and HVAC controls system, with embedded principles of high-quality environmental conditions and energy management and.
- 70.1.3.21 Ensure main contractor's responsibilities under relevant statutory legislation and recommended guidelines are fully satisfied
- 70.1.3.22 Ensuring that the installed mechanical services function reliably, are effective and operate to optimal efficiency.
- 70.1.3.23 Ensure the health, safety and comfort of occupants of the building.
- 70.1.3.24 Ensure energy efficiencies and energy reduction are core principles of the BMS control strategy.
- 70.1.3.25 Ensure policies and targets for energy saving and carbon reduction where these relate to systems controlled by the BMS are satisfied. Ensure that all potential avenues for energy reduction are considered and where appropriate that these proposals are presented with a rationale highlighting the benefits of such measures and any implications that may be associated with their implementation.
- 70.1.3.26 Maintain and protect the value of the mechanical services and BMS System assets and enhance the value of the investments made in campus buildings and its equipment.
- 70.1.3.27 The scope of BMS works as relates to this Contract shall be deemed to include all aspects of the following.
- 70.1.3.28 Maintain and protect the value of the mechanical services and BMS System assets and enhance the value of the investments made in campus buildings and its equipment.
- 70.1.3.29 BMS IT equipment to ensure network connectivity.
- 70.1.3.30 BMS Hardware to include, sensors, actuators, valves etc.
- 70.1.3.31 BMS Motor Control Centres and Outstations, incl controllers
- 70.1.3.32 BMS Software
- 70.1.3.33 BMS related building energy performance

70.2 Compliance, 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 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.
- 70.2.4 The system installation shall be in accordance with current NSAI Wiring Regulations.
- 70.2.5 Applicable Standards
- 70.2.5.1 All materials and work shall comply with the latest Irish and EU standards, including:
- NSAI National Rules for Electrical Installations (I.S. 10101:2020+A1:2024/AC2:2025).
 - The European Union (EU) EMC Directive 2014/30/EU.
 - Electromagnetic Compatibility Requirements
 - CIBSE/BSRIA Guides, including but not limited to:
- 70.2.5.2 CIBSE TM39 (Building Energy Metering)
- 70.2.5.3 CIBSE Guide F (Energy Efficiency in Buildings)
- 70.2.5.4 CIBSE Guide H (Controls)
- All relevant Health and Safety guidelines

70.3 Approved Manufacturers and Vendors

- 70.3.1.1 The controls specialist shall be an authorised OEM supported vendor of the Trend BMS system manufacturers. Evidence of this authorisation must be provided.
- 70.3.1.2 All equipment and ancillary components must be selected from the same manufacturers range.
- 70.3.1.3 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.

70.4 Documentation

- 70.4.1 The Contractor within his tender return must submit an outline technical proposal giving details of controllers and other principal 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.
- 70.4.2 The location of all devices is to be indicated on contractors' drawings and submitted for design team approval at least 4 weeks in advance of proposed first fix 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.
- 70.4.3 The Contractor shall provide all wiring schematics and layout drawings for the complete BMS installation, taking account of all specific requirements of plant or third-party equipment connected to the BMS. These drawings must identify connections and terminals to be used by the electrical contractor for all equipment.
- 70.4.4 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.
- 70.4.5 Functional Description of Operation outlining the complete control strategies and control attributes for each plant or subsystem.
- 70.4.6 Points list of all hardware and software assigned points.
- 70.4.7 Full technical data sheets and details of all devices and components proposed for use on the project.
- 70.4.8 Project management and installation plan.
- 70.4.9 Upon project completion the controls specialist will provide complete Operation and Maintenance instructions with as installed drawings.
- 70.4.10 As part of the Handover documents, the Contractor shall produce a detailed, system by system, plant by plant BMS HVAC Controls Asset Register. The Asset Register is to provide a detailed record to include, equipment item, manufacturer, vendor, make, model, specification and where known, date of installation. Each plant component shall be Asset Tagged in accordance with details on the register.
- 70.4.11 Tender Stage:
- 70.4.11.1 Tenders must include an outline technical proposal, details of principal components, and an outline points list to be considered valid.

70.4.12 Pre-Construction:

- 70.4.12.1 Before work commences, a complete technical submittal is required, including a Functional Description of Operation, full points list, data sheets, a detailed Data Plan, network schematics, and proposed graphics.

70.4.13 As Built:

- 70.4.14 Upon completion, the Contractor shall provide a complete set of 'as-built' drawings (in editable format), all application software, O&M manuals, and a detailed BMS/HVAC Asset Register.

70.4.15 Co-ordination

- 70.4.15.1 The Contractor is responsible for the full and proactive co-ordination of all BMS works with other trades. This includes conducting workshops (Network, Graphics, Analytics), reviewing layouts to ensure accessibility, and ensuring regular on-site attendance by the BMS Specialist to verify installation quality.

70.4.16 Installation & Workmanship

- 70.4.16.1 The BMS Specialist shall maintain the highest standards of quality control. The Contractor shall mark the precise location for all devices on drawings and in the field. The BMS specialist shall direct the mechanical and electrical contractors on the fitting and connection of all devices and shall continuously review cabling installations. Any modifications required due to incorrect installation shall be the Contractor's responsibility and at their cost.

70.4.17 Labelling

- 70.4.17.1 All control devices, isolators, and ancillaries shall be clearly and permanently labelled with a descriptive indication of the plant served (e.g., "Supply Fan DPS"). Space sensors shall be discreetly labelled on their interior for easy identification.

70.5 System Architecture & Technical Requirements

- 70.5.1 The system shall be a networked, stand-alone, distributed control system with a hierarchical topology. All controllers must be true peer-to-peer communicating devices; systems requiring polling are not acceptable. The maximum response time from an alarm occurrence to annunciation shall not exceed 5 seconds.
- 70.5.2 The system must be a non-proprietary "Open System."
- Vendor Neutrality: Components must be available from a minimum of 3 authorised vendors operating in Ireland.
 - Licensing: The Owner shall be the named and fully transferable license holder for all software.
 - Access: At project completion, the Owner shall receive all Administrator-level logins and passwords. No proprietary gateways or brand-specific tools shall be required for maintenance or modification.
- 70.5.3 Site-Wide Campus Integration, the Contractor shall include for the physical and logical connection of the new Building Management System to the existing site-wide campus network. The proposed BMS shall utilize the same manufacturer's software platform and network control architecture currently deployed across the campus (e.g., Tridium Niagara, Cylon, or equivalent as confirmed by the Client) to ensure a seamless, unified database and a single graphical user interface across all campus assets. The Contractor is responsible for all necessary licensing, head-end integration, and software mapping required to present the new building's data on the existing campus central workstation.
- 70.5.4 Network & Hardware
- 70.5.4.1 OT Network: The Contractor shall install and commission a dedicated Operational Technology Network (OTN), including switches and routers, which shall operate independently of the client's ICT networks.
- 70.5.4.2 Hardware: The system shall comprise Motor Control Centres (MCCs), outstations, DDC controllers, sensors, actuators, and all other required field devices. Each MCC/outstation shall have an RJ45 network connection.
- 70.5.4.3 Protocols: The system shall integrate third-party systems via open protocols such as BACnet, Modbus, and LonTalk. Physical connection for major equipment shall be via Ethernet/IP.
- 70.5.5 Software & User Interface
- 70.5.5.1 The system shall include a web-BMSed, HTML5 Graphical User Interface (GUI) accessible from any standard web browser without proprietary plug-ins. All communication shall be encrypted using TLS 1.3 or higher.
- 70.5.6 Cybersecurity
- 70.5.6.1 The BMS Specialist shall configure the system's cybersecurity in accordance with the manufacturer's "Cybersecurity Hardening Guide". This configuration shall include, as a minimum:
- Activation of a security dashboard.
 - Enabling of audit logs for all relevant functions.

- Integration with the Owner's directory services (e.g., LDAP/Active Directory).

70.5.6.2 Should the Owner's IT policies require configurations or services not covered in the standard Hardening Guide, the BMS Specialist shall formally notify the Engineer in writing. This notification shall identify the deviation from the guide and detail any potential impact on cost and programme for review and instruction.

70.5.7 Data, Analytics, and Fault Detection (FDD)

70.5.7.1 Data Tagging: All data points shall be tagged with metadata in accordance with an industry-standard ontology to be agreed upon in a workshop.

70.5.7.2 Analytics & FDD: The system shall include an integrated FDD and analytics framework to identify operational faults and prioritize issues, fully integrated into the main UI.

70.6 Building Automation and Control System Outline Points List

70.6.1 The Contractor and their engaged specialist BMS and Controls contractor shall refer to M70 - Appendix for associated Building Management System Outline Points Lists.

70.6.2 Points Lists appended to this specification are to be read in conjunction with descriptions of operation, general arrangement drawings, system schematics and all other mechanical and electrical drawings. The Points List is illustrative of the design intent and the basis of control and operation of principle elements of the BMS. The Contractor shall be expected to include all necessary points as required, even where not scheduled within the lists.

70.6.3 The Controls specialist shall be responsible for the development of a complete Points List based on the functional operational strategy for all elements of the BMS installation. The points list will be reflective of the specific requirements of the proposed system. The specialist's points list is to be submitted to the engineer for comment or approval in advance of commencement of any works.

70.6.4 The Controls specialists shall refer to CIBSE and BSRIA Application Guides in the development of the points list and operational control strategies. The Points list provided does not list pseudo control points or software assigned control points and shall not be taken to be an exhaustive list of the system requirements.

70.6.5 A spare capacity allowance shall be maintained in all controllers and within MCC's / outstations for 25% additional control points. These spare points shall be wired to terminal

70.7 Materials & Equipment

70.7.1 General Requirements

70.7.1.1 All products and materials shall comply with the project specification and relevant standards. All similar items of equipment shall be from a single, approved manufacturer's range to ensure consistency. Samples of visible devices must be submitted for approval before ordering.

70.7.2 System Controllers

- 70.7.2.1 All controllers shall utilise DDC technology and be of a modular design with universal I/O.
- 70.7.2.2 The Tenderer is responsible for calculating the total I/O point count, including physical and software points.
- 70.7.2.3 Each controller must include a spare I/O capacity of 25% for each signal type, wired to terminals.
- 70.7.3 Field Devices & Sensors
- 70.7.3.1 All sensors (temperature, humidity, CO₂), valves, and actuators shall be provided as required to meet the control strategy.
- Temperature Sensors: All temperature sensors shall use PT1000 sensing elements unless otherwise specified.
 - Duct and Immersion Temperature Sensors: For temperature sensing in ductwork and via immersion pockets in pipework and vessels.
 - Accuracy: Shall be equal to or better than $\pm 0.5^{\circ}\text{C}$ at 21°C .
 - Probe Construction: Probe shall be constructed from V4A stainless steel. For liquid applications, the probe shall be installed within a stainless-steel pocket (thermowell).
 - Housing: The enclosure shall be constructed from PC (Polycarbonate) with a minimum protection rating of IP65 / NEMA 4X.
 - Operating Environment: The sensor shall be rated for operation in an ambient temperature range of -35 to 50°C and a fluid temperature range of -50 to 160°C .
 - Room Space Temperature Sensor: For dedicated space temperature sensing, these sensors shall be provided.
 - Temperature Sensing Element: Active sensor with adaptive temperature compensation.
 - Accuracy (Temperature): Shall be equal to or better than $\pm 0.3^{\circ}\text{C}$ at 25°C .
 - Housing: The enclosure shall be wall-mounted, constructed from PC (Polycarbonate), and have a minimum protection rating of IP30.
 - Operating Environment: The sensor shall be rated for operation in a temperature range of 0 to 50°C and a relative humidity range of 0 to 95% (non-condensing).
 - Combined Temperature and CO₂ Sensors: Where required by the control strategy for combined space sensing, these sensors shall be provided.
 - CO₂ Sensing Element: Shall use Non-Dispersion-Infrared (NDIR) dual-channel technology.
 - Temperature Sensing Element: Active sensor with adaptive temperature compensation.
 - Accuracy (CO₂): Shall be equal to or better than $\pm(50 \text{ ppm} + 2\% \text{ of measured value})$.
 - Accuracy (Temperature): Shall be equal to or better than $\pm 0.3^{\circ}\text{C}$ at 25°C .
 - Housing: The enclosure shall be wall-mounted, constructed from PC (Polycarbonate), and have a minimum protection rating of IP30. Operating

Environment: The sensor shall be rated for operation in a temperature range of 0 to 50°C and a relative humidity range of 0 to 95% (non-condensing).

- Black Bulb Temperature Sensors: Where required by the control strategy for measuring radiant heat, black bulb temperature sensors shall be provided.
- Sensing Element: Shall be PT1000a.
- Accuracy: Shall be equal to or better than $\pm 0.2^{\circ}\text{C}$ at 25°C.
- Construction: The sensor shall consist of a sensing element housed within an anodised aluminium black bulb.
- Housing: The enclosure shall be wall-mounted, constructed from flame-retardant ABS with a minimum protection rating of IP30.
- Operating Environment: The sensor shall be rated for operation in a temperature range of -10 to 60°C and a relative humidity range of 0 to 95% (non-condensing).

70.7.4 Control Valves

70.7.4.1 The BMS specialist shall be responsible for the supply and final selection of all control valves, actuators, and associated linkages. The selection shall be made in strict accordance with the design intent and in consultation with the valve manufacturer (e.g., Belimo or equivalent).

70.7.4.2 The BMS specialist shall provide the manufacturer with all relevant design drawings, system schematics, and operational strategies, the manufacturer and BMS specialist shall collaborate to:

- Determine Valve Type: Select the appropriate valve type (e.g., 2-way Characterised Control Valve, 3-way mixing/diverting valve, 6-way changeover valve, Globe Valve, or Butterfly Valve) based on the specific hydronic circuit design (e.g., injection, throttling, changeover).
- Utilise Pressure-Independent Valves: Where specified for terminal units or critical zones, pressure-independent valves shall be used to ensure correct flow regardless of system pressure fluctuations, simplify hydronic balancing, and improve control stability.
- Develop Sizing Schedule: For conventional pressure-dependent valves, a comprehensive sizing schedule must be developed. This process shall include:
- Calculation of the required flow rate (V) based on the specified thermal load (Q) and design temperature difference (ΔT).
- Calculation of the required flow coefficient (Kv).
- Selection of the appropriate valve size (Kvs) to achieve a valve authority) of ≥ 0.5 , ensuring optimal control stability.
- Ensure System Integrity: All selected control valves must be tight-closing (Leakage Rate A, air-bubble tight per EN 12266-1) to prevent energy loss during zero-load conditions.
- Strainers shall be installed upstream of all control valves to protect them from debris and ensure long-term operational reliability. Water quality must adhere to VDI 2035 guidelines.
- The BMS specialist must obtain formal, written recommendations from the manufacturer confirming that the selected valves, sizing, and locations are

appropriate to ensure the system is commissionable and will operate according to the design intent.

- The final valve design, schedule, and manufacturer recommendations must be submitted to the engineering team for review and approval before any materials are ordered.

- 70.7.4.3 Actuators shall be 24V AC/DC as standard. 230V AC may be used only where explicitly required by the electrical design and approved by the Engineer.
- 70.7.4.4 All actuators shall be equipped with a manual override mechanism (e.g., push-button gear disengagement or hand crank) to allow for manual positioning during commissioning, servicing, or in the event of failure.
- 70.7.4.5 Where fail-safe operation (fail-open or fail-closed) is specified, actuators shall be of the spring-return type.
- 70.7.4.6 Modulating valve actuators shall be communicative and support the project's specified protocol (e.g., BACnet, Modbus) to allow for digital control, feedback of valve position, and diagnostics.
- 70.7.4.7 All valve actuators shall be installed in strict accordance with the manufacturer's recommendations and the relevant CIBSE Commissioning Codes. As a minimum, actuators must be installed in an upright or horizontal position; installation in a suspended (upside-down) orientation is not permitted.
- 70.7.4.8 All control valves shall be supplied with measuring stations to allow for the independent, physical verification of flow rates. This is in addition to any electronic verification method the valve may possess.
- For each valve, a minimum of three pressure/temperature (P/T) ports shall be installed in the configuration recommended by the manufacturer.
 - One pair of ports shall measure the pressure differential across the associated coil, and another pair shall measure the pressure differential directly across the Pressure Independent Valve. This is to verify both the coil flow rate and that the valve is operating within its required differential pressure range.
 - The physical measurement and verification of flow rates at design conditions must be witnessed by the engineer. During this verification, the valve must be commanded to the design flow position via the Building Management System (BMS). Manually opening the valve with its override handle for this procedure is not permitted.
 - Reliance on the valve's internal electronic flow sensor readings or manufacturer-tested documentation alone will not be accepted for final system sign-off.
- 70.7.4.9 All modulating and open/close control valves shall be installed with a bypass arrangement to facilitate system flushing, commissioning, and maintenance. The bypass assembly shall consist of:
- Two (2) isolation valves to allow the control valve to be removed without draining the system.
 - One (1) regulating valve, of the same nominal size as the main pipework, to provide a means of manual flow control during maintenance or in the event of actuator failure.

- During normal operation, all bypass valves must be fully closed to ensure the system functions as designed

70.7.5 Damper Actuators

- 70.7.5.1 Fail-safe damper actuators that meet the current BSRIA AG9 guidelines. The actuators are to be used for adjusting dampers in the building's technical installations.
- 70.7.5.2 Ensure the actuator nominal torque is sufficient for the damper size and application. The selection must be based on the information and data provided by the damper manufacturer, taking into account the damper's cross-section, design, installation situation, and ventilation conditions.
- 70.7.5.3 For actuators requiring status feedback (e.g. open/close), provide models with integrated Single Pole Double Throw auxiliary switches. The switches shall be set to prove the damper's operational status (e.g., 90% open).
- 70.7.5.4 Install all damper actuators in strict accordance with the manufacturer's installation instructions.
- 70.7.5.5 Where an actuator is positioned outdoors or in an area exposed to extreme conditions, it must have a minimum ingress protection rating of IP66/67 / NEMA 4X. For standard indoor applications, a minimum rating of IP54 is required.
- 70.7.5.6 All actuators must be fitted with a clear mechanical position indicator to provide visual confirmation of the damper's current position.
- 70.7.5.7 The actuator must feature a manual override mechanism, such as a hand crank or a push-button for gear train disengagement, to allow for manual positioning during power failure or maintenance.
- 70.7.5.8 Where dampers are required to fail-open or fail-closed upon loss of power, a fail-safe actuator with a spring return mechanism shall be used. The direction of fail-safe rotation shall be selectable by the mounting orientation of the actuator (left or right).
- 70.7.5.9 Modulating actuators shall be controlled by a standard analog control signal (e.g., 1-10V) from the Building Management System (BMS). Position feedback shall be provided via a corresponding analog signal.

70.7.6 Differential Pressure Switches

- 70.7.6.1 Differential pressure switches are to be used for status indication on fans and for monitoring differential pressure in air systems i.e. filters etc. These switches shall be designed for use with air or other non-combustible, non-aggressive gases and are not suitable for liquid or hydraulic applications such as pump status indication. The switches are to be supplied complete with a mounting kit that includes a 2-meter PVC sensing tube and two plastic duct connectors. No Current Transducer/Transmitter (C.T.) switches shall be allowed without prior approval from the Engineer.
- 70.7.6.2 All pumps and booster pump sets are to be supplied with integrated differential pressure switches for status indication. The Contractor must coordinate with the BMS Specialist prior to ordering to ensure the integrated switches are compatible with the Building Management System. If integrated switches are not available for the selected equipment, the BMS Specialist shall be responsible for supplying and installing suitable standalone differential pressure switches.

70.7.7 Power Consumption Meters

70.7.7.1 Power consumption meters are being provided under the electrical services contract but shall be interfaced with the BMS to provide Energy monitoring (kWhr), Current Usage (A) and outputs for each distribution and load centre. Meters shall incorporate ModBus interface, and all energy data is to be reflected on BMS graphics and energy monitoring trend data.

70.7.8 Occupancy Sensors

70.7.8.1 Occupancy sensors to engage ventilation & Urinals within toilets shall be supplied by the BMS contractor.

70.7.8.2 The sensors shall be passive infra-red (PIR) motion detectors suitable for surface-mounted ceiling installation. The units must have a minimum

70.7.8.3 IP44 rating (when fitted) and a dedicated floating relay channel for HVAC control.

70.7.8.4 The sensors shall provide a circular 360° detection area. At a mounting height of 3 metres, the detection range must have a radius of at least 4 metres for head-on approach, covering an area of up to 50 m².

70.7.8.5 Key technical requirements for the detector shall be:

- HVAC Control: Required, must feature a dedicated presence channel. Refer to ventilation control strategy.
- Presence Switch-off Delay: Configurable from 10 seconds to 120 minutes.

70.7.9 Outside Temperature Sensors.

70.7.9.1 The sensor shall not be installed under eaves, above windows, or above ventilation extracts.

70.7.9.2 The sensor shall be mounted on a north-facing wall, away from direct sunlight, to ensure unbiased detection of the ambient temperature.

70.7.9.3 A radiation shield shall be provided with the sensor to protect it from direct solar radiation and precipitation, ensuring accurate ambient temperature readings.

70.7.9.4 The sensor element shall be compatible with the BMS controller input, with available types including Pt 1000, NTC 10k, or NTC 20k.

70.7.9.5 The sensor shall have a minimum accuracy of $\pm 0.2^{\circ}\text{C}$ at 25°C .

70.7.9.6 The sensor shall be capable of operating within a sensing range of at least -40°C to $+70^{\circ}\text{C}$.

70.7.9.7 The sensor enclosure shall be constructed from Polycarbonate (UL94-V0 approved) and provide a minimum protection class of IP65

70.7.10 IT & Network Equipment

70.7.10.1 The Contractor shall provide a dedicated and independent BMS Operational Technology Network (OTN), including all fibre, cables, patch panels, and managed network switches with PoE capability.

70.7.10.2 All BMS workstations and network switches shall be provided with a dedicated UPS providing a minimum of 30 minutes of backup power.

70.7.11 Operators Keypad Units

- 70.7.11.1 Each of the MCC/ control panels is to be fitted with a panel mounted operators touchscreen interface.
- 70.7.11.2 Each of the touch screen shall provide as a minimum the following standard functions.
- 70.7.11.3 Plain language text and graphical information display
- 70.7.11.4 Password protected Menu driven access to point data.
- 70.7.11.5 Access to change time programs and set points.
- 70.7.11.6 Access to energy meter readings
- 70.7.11.7 Manual override of automation strategies
- 70.7.11.8 View / override Device status
- 70.7.11.9 View Temperature and other sensor values
- 70.7.11.10 Boost Heating Control
- 70.7.12 System Graphics
- 70.7.12.1 All new plant either controlled or monitored by the Building Automation and Control system shall be integrated to the new BMS and represented by a graphical display on the "front end". All graphics shall be presented in a highly graphical and descriptive user-friendly format which shall permit users, following training, to browse and interact with the system with confidence.
- 70.7.12.2 The graphics shall clearly indicate all items of plant and shall provide clear indication of plant status.
- 70.7.12.3 All controls points shall be accurately displayed on the graphics system, to include floor plan layout for easy identification, along with graphical schematic representation of the complete system.
- 70.7.12.4 The following outlines the minimum expected graphics to be provided. The contractor will be responsible for determining the most appropriate layout of graphic tiles. The contractor shall submit to the engineer all proposed graphics for comment or approval in A4 Colour format.
- 70.7.12.5 Site Graphic
- 70.7.12.6 Opening graphic to indicate the various HVAC and water systems
- 70.7.12.7 Heating Plant
- 70.7.12.8 Water Services Plant
- 70.7.12.9 Ventilation Plant
- 70.7.12.10 Air Conditioning plant
- 70.7.12.11 General plant and miscellaneous equipment monitoring
- 70.7.12.12 Energy Metering
- 70.7.12.13 Trend logged data interface (**minimum period 8 week, 24hrs/day data logs at 1min intervals**)
- 70.7.13 Remote Alarm Monitoring

- 70.7.13.1 The system shall include a remote alarm enunciator, complete with a mute button, installed in a location approved by the Engineer and the Client. The unit shall activate upon receiving a critical alarm from any primary plant or system.
- 70.7.13.2 The system shall provide a remote alarm to activate on receipt of a critical alarm condition on primary plant or systems and shall provide a signal to the client via email and / or sms message to staff.
- 70.7.14 System Configuration
- 70.7.14.1 The system shall be configured to separately access the plant for alteration of set points from that of monitoring systems via password authentication.
- 70.7.14.2 The system shall be configured from the outset to provide trend logs on primary plant and principal spaces.
- 70.7.14.3 The system shall be configured from the outset to provide periodic reports and automatically generate statements on energy usage for metered areas etc.
- 70.7.14.4 The contractor will allow for miscellaneous and ad-hoc system modifications as required by the client to the satisfaction of the engineer. Following handover, the controls specialist shall include for one day's site attendance to make such adjustments as may be required following the initial occupancy of the building.
- 70.7.15 Front End User Interface
- 70.7.15.1 The Contractor shall include for updates to the "front end" operator interface, to include updates to current revisions of the manufacturer's software, application of updates etc.
- 70.7.15.2 Trending and reporting functions shall be configured for all plant and connected devices.
- 70.7.15.3 Alarm handling functions shall be reviewed such that critical alarms are identified separately to common alarms.
- 70.7.16 Front End User Interface: Workstations
- 70.7.16.1 The Contractor shall be responsible for the complete provision of all BMS related PC Workstations, to include monitors and peripheral devices.
- 70.7.16.2 The specification of the workstation and operating systems shall be as recommended by the BMS Original Equipment Manufacturer, based on the software applications and project requirements.
- 70.7.17 BMS Network switches
- 70.7.17.1 The Contractor shall be responsible for the complete provision of all BMS related comm's networks. The operation of the BMS shall not rely on the availability of client ICT networks and the BMS system shall be configured to operate on a dedicated BMS network independently of client ICT.
- 70.7.17.2 The Contractor shall be responsible for the complete provision of the BMS ICT Network as part of the BMS installation. Where the contractor does not have in house expertise in this regard it is expected that an appropriate and competent sub-contractor will be appointed by the contractor to carry out this work. The BMS ICT Network consists of Fibre Optic installations, network switches, cables, leads and patch panels.
- 70.7.17.3 The BMS network shall be equipped with the following.

- Physical Port
- Gigabit (10/100/1000Mbps) Fast Ethernet ports with PoE Injector
- 2 10/100/1000Mbps TP and SFP shared combo interfaces
- RS-232 male DB9 console interface for Switch basic management and setup
- Reset button for system management.
- Power over Ethernet
- Complies with IEEE 802.3af Power over Ethernet End-Span PSE
- Up to 24 IEEE 802.3af devices powered.
- PoE Power up to 15.4 Watts for each PoE port
- Auto detect powered device (PD)
- Circuit protection prevents power interference between ports.
- Remote power feeding up to 100m.
- PoE Management
- Total PoE power budget control
- Per port PoE function enable/disable
- PoE Port Power feeding priority
- Per PoE port power limit
- PD classification detection
- BMS switches and BMS workstations shall be supplied complete with a dedicated.
- UPS back-up capable of maintaining power for a period of 30mins.
- The BMS Switches shall be rack mountable and shall be located in the comm's racks.
- Switches should be Layer 2, 24 port Gigabit PoE switches with "Gbic" Connections for fibre connectivity

70.7.18 Client Software

- 70.7.18.1 BMS controller compatible Graphical User Interface Application software will be the user interface for viewing all aspects of the BMS systems. Real time and recorded trend log data shall be displayed on any client computer using a proper login and password.
- 70.7.18.2 Client Software will be available to be installed on up to four workstation clients as required by the user.
- 70.7.18.3 Client Software access will be User Account Controlled such that an operator must enter their credentials and will only have functionality prescribed to by the set of Roles assigned to their user account by their administrator. User Roles shall limit the ability to view, change setpoints, or perform more detailed operations.

70.8 Samples

- 70.8.1 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. Samples shall be provided for architectural approval for all sensors that will be visible in rooms. Samples of duct and pipe mounted devices shall be provided to demonstrate technical performance characteristics.
- 70.8.2 Any costs associated with the provision of samples must be included by the contractor.

70.9 Co-ordination

- 70.9.1 The Contractor shall note his responsibility for co-ordination of all works with other contractors and sub-contractors, ensuring all necessary works and requirements for all BMS connected plant, connected equipment or interfacing with third party systems is understood and in the accordance with the expectations and requirements of the specifications and works requirements.
- 70.9.2 The Contractor shall co-ordinate all requirements with other services and systems suppliers, to ensure all necessary information such as power supplies, wiring arrangements, connection details, compatibility and communications protocols etc., are clearly understood and considered in the BMS system technical proposals.
- 70.9.3 The Contractor shall review mechanical and electrical layouts with other contractors during early-stage co-ordination and prior to any installation. The Contractor shall indicate locations on drawings utilising space efficiently to maximise accessibility for other installations and for future access and maintenance. This may influence the configuration of MCC panels. Access for maintenance of controls devices, sensors and actuators shall also be considered in this respect.
- 70.9.4 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 contractor's programme and finishes, the costs of which may be directed to the responsible Contractor.
- 70.9.5 The Contractor will make available the appropriate qualified personnel for attendance at regular site co-ordination meetings.

70.10 Quality Control and Workmanship

- 70.10.1 The BMS specialists shall be responsible for on-site installation quality control of the BMS and controls installations. As such the BMS specialist shall 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. Any modifications to installed systems that are deemed necessary due to incorrect installations, incorrect locations of devices, inadequate space / access for maintenance etc., shall be the responsibility of the contractors. Any associated costs shall be borne by the contractors.

70.11 Contractor & BMS Specialist Qualifications

- 70.11.1 The appointed BMS Specialist must be an authorised OEM-supported vendor Trend demonstrate:
- BMS Project Engineer to have a minimum of 5 Years experience in BMS and Controls, with management and senior technical resources to have minimum 10 years' experience in BMS Controls.
 - A history of at least three successful projects of similar size, with references provided in the submittal.
 - A local service Engineer, within 50 miles (80 km) of the site.
- 70.11.2 Key Personnel Experience
- 70.11.3 The BMS Project Engineer must have a minimum of 5 years of experience in BMS and Controls. Additionally, management and senior technical resources must have a minimum of 10 years of experience in BMS Controls, hold the highest level of certification on the proposed platform, and possess demonstrable project experience in enterprise-level, multi-protocol, and multi-platform integration.

70.12 Control Systems Description of Operation

- 70.12.1 The fundamental purpose of the Building Management System (BMS) is to provide centralised monitoring and control for all HVAC plant. The control strategies developed shall ensure system reliability, high levels of occupant comfort, and optimal energy efficiency as core principles. The system will integrate all building services into a single platform with a unified graphical user interface.
- 70.12.2 The BMS Specialist, engaged by the Contractor, shall be responsible for developing a complete and detailed functional operational strategy for all elements of the BMS installation. This strategy must fully expand upon the design intent illustrated in the contract drawings and specifications. This final strategy document, often termed the Functional Description, must be submitted to the engineer for review and approval before any works commence.
- 70.12.3 The BMS Specialist shall refer to the latest CIBSE and BSRIA Application Guides in the development of all operational and control strategies. This is to ensure industry best practices are followed for energy efficiency and system performance.
- 70.12.4 Before deploying to the site, the BMS Specialist shall present the control strategy software for bench testing or simulated operation at an agreed-upon premises for verification.
- 70.12.5 The BMS Specialist shall provide a local warning indicator for common faults, installed in a location to be agreed upon with the client and engineer on site.

- 70.12.5.1 Prior to witness testing, the Contractor must provide evidence that the circuits are fully vented and free of air. This shall be demonstrated using a calibrated thermal imaging camera to show a complete and even heat distribution across all emitters.
- 70.12.5.2 Radiant Panel Control Strategy
- 70.12.5.3 The radiant panels shall be served by a Existing LPHW heating circuit The system's operation will be enabled by an operator-adjustable time schedule within the BMS, initially set for 07:00 to 23:00.
- 70.12.5.4 During the scheduled-ON period, the BMS will modulate the control valves serving the radiant panels to maintain the space temperature setpoint (initially 21°C).
- 70.12.5.5 Temperature Sensing & Sensor Placement: Control of the radiant panels shall be based on black bulb temperature sensors, which are designed to accurately measure the combined effect of radiant and air temperature in the occupied space.
- 70.12.5.6 Frost & Fabric Protection, In addition to the operational setback, a hard-limit frost protection mode (e.g., 10°C) shall be active at all times (including holidays) to protect the building fabric and pipework from freezing.
- 70.12.5.7 The BMS shall record Trend Logs for every zone temperature and motorised valve position. These logs shall be stored for a minimum of 12 months and viewable via the BMS front end for performance analysis.
- 70.12.5.8 The BMS Specialist shall be responsible for reviewing and agreeing to the final installation location of all black bulb sensors in coordination with the design team. This is to ensure they are positioned for accurate and representative readings, away from sources of interference such as direct sunlight or drafts.
- 70.12.5.9 Heating to individual panels or small groups of panels shall be controlled by motorised Pressure Independent Control Valves (PICVs). To ensure minimum circuit flow and prevent pump 'dead heading' when all PICVs are closed, the final panel on each circuit shall have end of line valve installed
- 70.12.5.10 Prior to the official witness testing and demonstration of the control strategy, the Contractor must provide evidence that the radiant panel circuits have been fully vented and are free of air. This shall be demonstrated using a calibrated thermal imaging camera to show a complete and even heat distribution across all panels.
- 70.12.5.11 For general out-of-hours use, the BMS specialist shall provide a local boost controller. This controller shall allow for manual system activation with user-selectable durations of 1, 2, 3, or 4 hours. Once activated, the system shall run for the selected duration before automatically reverting to the scheduled mode.
- 70.12.5.12 BMS Integration & Communication:
- Through this interface, the BMS shall monitor and log data from each zone, including the current temperature, setpoint, and heating status.
 - The BMS shall have the ability to remotely adjust setpoints, change operating modes (e.g., from comfort to frost protection), and lock the local keypad on any thermostat to prevent unauthorised changes.

70.12.5.13 Fan Speed Control (Trickle & Boost): As the unit serves Seclusion Room and Anti – Room, the supply and extract fans shall operate on a two-stage "Trickle and Boost" strategy determined by the Relative Humidity (RH) levels measured within the common return air ductwork.

- Trickle Mode: Under normal conditions, the fans shall operate at a reduced continuous speed (adjustable, e.g., 40%) to provide minimum background ventilation.
- Boost Mode: When the measured Return Air Humidity rises above the high-limit setpoint (adjustable, e.g., 60% RH), the fans shall ramp up to the Boost speed (adjustable, e.g., 100%) to rapidly purge moisture from the spaces.
- Run-on Timer: Once the humidity level drops below the setpoint (minus an adjustable hysteresis deadband), the fans shall continue to operate at Boost speed for a run-on period (adjustable, e.g., 15 minutes) before reverting to Trickle mode.

70.12.6 Extract Fan and Supply Fan Operation

- 70.12.6.1 Packaged Extract Fans (EFs) and Supply fans are provided for general ventilation as indicated on IN2 Engineering M20 layout drawings and schematics. The extract fans and Supply fans derive their power from, and operate under the control dictates of, the associated Motor Control Centre (MCC) outstation.
- 70.12.6.2 The packaged extract fans and Supply fans for general ventilation shall be of a mixed-flow type. Each fan must be equipped with a high-efficiency, electronically commutated (EC) motor capable of stepless speed control.
- 70.12.6.3 The fan's speed and operation will be directly controlled by the BMS. To achieve the desired control strategy, the fan installation shall include:
- Direct BMS 0-10V Control: The fan's EC motor shall be wired to accept a 0-10V analogue control signal from the BMS for stepless speed modulation (ramping up for boost and down for trickle).
 - Presence Detector: A compatible PIR motion sensor shall be installed and wired as an input to the BMS. **which shall be supplied and installed by the BMS specialist.**
- 70.12.6.4 Enable & Speed Control: The BMS will enable the fan and control its speed by sending a variable 0-10V signal. This signal will dictate the fan's status (Off, Trickle, or Boost).
- 70.12.6.5 The BMS shall monitor the fan's tachometer speed output terminal. If the BMS is sending a run command (a voltage signal > 0V) and receives no pulse feedback from the tachometer output, a common fault alarm shall be raised.
- 70.12.6.6 The extract fan and Supply fans shall operate according to the following logic programmed within the BMS:
- Time Schedule: The fan is enabled by an operator-adjustable time clock within the BMS, initially set to operate from 07:00 to 23:00. Outside this schedule, the fan will remain off unless manually overridden.
 - Trickle Ventilation: During the scheduled-ON period, the fan will run at a low-speed "Trickle" setting. This speed will be determined by a commissioning setpoint in the BMS (e.g., a 3V signal).
 - Run-On Timer: When the space is vacated, the PIR signal will cease. The BMS will then hold the fan in "Boost" mode for a 15-minute run-on period. After this timer expires, the fan will ramp down to the "Trickle" setting.
- 70.12.6.7 Fire Alarm Interlock: On receipt of an activation signal from the fire alarm system, the BMS will immediately disable the extract fan. The fan shall automatically resume its normal operational sequence once the fire alarm system has been cleared.

70.12.7 Air Conditioning Control Strategy

70.12.7.1 The BMS specialist shall coordinate with the Contractor and their Air Conditioning specialist to ensure the proposed AC system is supplied complete with all necessary BACnet / Modbus interface, gateways, accessories, and software points required to achieve the full scope of the control strategy detailed herein. All costs for these items shall be deemed to be included by the Contractor.

70.12.7.2 The external AC external condenser unit shall derive their power the main electrical boards as indicated on IN2 Engineering layout and schematic drawings. The BMS shall monitor the run status and the trip/fault status for each system.

70.12.7.3 The BMS shall monitor the following points for each indoor unit as a minimum:

- Space Temperature: The current temperature read by the temperature sensor.
- Active Setpoint: The current target temperature.
- Operating Mode: Cooling, Heating, Fan Only, Auto, or Off.
- Fan Speed: Current speed setting (e.g., Low, Med, High, Auto).
- Unit Status: On / Off / Standby.
- Filter Status: Clean / Dirty alarm.
- Fault Status: A binary point indicating a fault condition, with the specific fault code available for diagnostics.

70.12.8 General Air Conditioning Controls

70.12.8.1 The BMS shall monitor the provided refrigerant leak detection system via a BACnet / Modbus interface. This applies whether the system proposed by the contractor is integral to the AC units or a standalone solution. Any alarm from the leak detection system shall generate a single, high priority "AC Refrigerant Leak Detected" alarm on the BMS, clearly identifying the specific location of the leak.

70.12.8.2 Power Failure: Loss of power to any external condenser unit (monitored via the associated SDB) shall generate an alarm on the BMS.

70.12.9 Fire Alarm Interface

70.12.9.1 The Fire Alarm Specialist Contractor shall provide a dedicated, normally closed, volt-free contact to each Motor Control Centre (MCC) and BMS outstation. This contact shall open upon the activation of the building's fire alarm system to signal a fire condition.

70.12.9.2 Upon receiving a fire alarm activation signal from the Fire Alarm Panel (typically via a volt-free contact opening), the Building Management System (BMS) shall immediately and automatically initiate a controlled shutdown of all designated mechanical plant. This action is critical to prevent the circulation of smoke through ventilation systems and to shut down fuel sources, supporting the building's overall fire safety and evacuation strategy.

70.12.9.3 The shutdown sequence shall include, but is not limited to, the following actions:

- Ventilation Systems:
- All general supply and extract fans throughout the building shall be de-energised.

- All associated motorised dampers within the ductwork shall be commanded closed. The actuators must be of a fail-safe, spring-return type, ensuring they automatically drive to the closed position upon de-energisation or power failure to fully isolate the ductwork.

70.12.10 Miscellaneous Plant and Equipment Monitoring

70.12.10.1 The Building Management System (BMS) shall act as a central monitoring point for the operational status and critical alarms of various third-party and standalone plant systems. The BMS Contractor shall be responsible for providing the necessary input points on the BMS and for integrating the signals provided by other specialist contractors.

70.12.10.2 Where "monitoring" is specified, it shall, as a minimum, consist of the following volt-free signals to be provided by the relevant third-party supplier for connection to the BMS:

- Plant Running / Active: A signal indicating the equipment is operational or active.
- General Fault / Alarm: A summary fault signal indicating an alarm condition within the equipment.
- Power Healthy / Available: A signal indicating that mains power is available to the unit's local control panel.

70.12.10.3 The BMS shall monitor the following systems. The specific signals required for each are detailed below:

- Enable / Disable
- Run Status
- Temperature Sensor on return duct
- Common fault / alarm
- Heating / Cooling mode
- Room Temperature
- Temperature Setpoint
- Supply air temperature
- Filter dirty alarm
- Supply Fan :
- Start / Stop Command
- Run status
- Fan fault / trip
- Airflow proof or duct pressure
- Speed reference / feedback
- Extract Fan :
- Start / Stop command
- Run Status
- Fan fault / trip

- Airflow proof or duct pressure
- Speed reference / feedback
- Room Served
- Co2 Level
- Fire Alarm Interface :
- Fire-alarm shutdown signal
- Fan shutdown configuration

70.12.11 Energy Metering and management

70.12.11.1 In accordance with the principles of CIBSE TM39 (Building Energy Metering), a comprehensive metering system shall be provided to give a granular overview of energy and water consumption throughout the facility. The BMS shall be the central platform for the monitoring, recording, and long-term storage of all metering data.

70.12.11.2 Electrical Energy Metering: Electrical energy meters shall be installed to monitor the main incoming power and all significant energy users. The BMS shall monitor and log, as a minimum, the following points from each electrical meter:

- Cumulative Active Energy (kWh)
- Cumulative Reactive Energy (kVARh)
- Instantaneous Demand (kW)
- Voltage (V) and Current (A) per phase
- Power Factor (PF)

70.12.11.3 Meters shall be installed to monitor the following:

- The main incoming electrical supply to each Electrical Board and MCC panel.

- 70.12.11.4 The BMS specialist is responsible for developing a complete metering strategy that fully captures the design. The specialist must conduct a thorough review of all IN2 Engineering mechanical and electrical specifications, layout drawings, and schematics to ensure all metering requirements are identified and incorporated into the BMS.
- 70.12.11.5 Data Monitoring, Logging, and Reporting: The BMS shall be configured to continuously monitor all specified energy and flow meters. It shall log the data at user-configurable intervals (not exceeding 15 minutes) and store this historical data for a minimum period of 24 months. The system shall be capable of analysing this data and presenting the information through user-friendly dashboards, trend graphs, and customisable reports that can be exported.
- 70.12.11.6 Power for the external lighting circuits shall be derived from the External Lighting Distribution Board. The Distribution centre shall be supplied under the electrical services contract and is to be complete with contactors and Hand/Off/Auto switches to permit BMS control of the External Lighting.
- 70.12.11.7 A Photocell mounted on a north face connected to the BMS shall engage the External Lighting at dusk and shall operate thereafter under the dictates of an operator adjustable BMS time schedule, initially set to turn lights OFF at 01.00am or a time specified by the client.
- 70.12.11.8 The Controls Specialist shall liaise with the Electrical Contractor and security systems Specialist and shall ensure that the external lighting is configured with flexibility in order to achieve the following matrix.
- 70.12.11.9 Circuit References shall be cross referenced against IN2 drawings. Separate time zones shall be configured such that facade or building mounted luminaires, car-park luminaires, landscape, feature façade lighting, and decorative luminaires shall be controllable to operator defined time schedules in order to maximise opportunities for energy saving.
- 70.12.11.10 The external lighting shall be interfaced with the security systems such that an activation event will engage appropriate external lighting as a deterrent to intruders, assistance to the CCTV systems and those responding to an alarm activation.

70.13 Installation

- 70.13.1 The Contractor along with their BMS Specialist shall be expected to indicate the precise recommended location for all controls devices on layout drawings and shall also mark the locations of all devices in the field.
- 70.13.2 In advance of site first fix commencement, the Contractors shall arrange a review meeting to review all requirements in order that all requirements are understood.
- 70.13.3 The Contractor shall review electrical installations of all controls cabling on an ongoing basis, confirming suitability of the installation, that cable types as per BMS requirements etc.
- 70.13.4 The Contractor shall be expected to verify the locations of all sensors in the field during early first fix stages and where considered necessary shall make recommendations for repositioning of sensors where it is deemed that the current position would affect accuracy of the system.

- 70.13.5 The MCC's shall be supplied by the controls specialist and placed in position. Final electrical connection shall be by the electrical contractors under the direction of the control's specialists.
- 70.13.6 All controls devices shall be shipped to site labelled for the location to be fitted etc. Fitting of mechanical devices such as valves, pipe pockets, duct, AHU, heat recovery sensors, actuators etc., shall be by the mechanical contractor with electrical connections and mounting of wall mounted sensors by the electrical contractor, all under the direction of the control's specialists.
- 70.13.7 The Contractor shall be expected to verify the locations of all sensors in the field and were considered necessary shall make recommendations for repositioning of sensors where it is deemed that the current position is affecting accuracy of the system.

70.14 Commissioning, Testing & Inspections

- 70.14.1 The Contractor and controls specialist 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 referenced in the specifications.
- 70.14.2 The Contractor shall take a lead role in the management of the commissioning process and ensure that there is close liaison between the mechanical systems commissioning engineers and the Controls Specialists commissioning engineers. Controls systems commissioning reports are to be completed by the Controls Specialist and submitted to the Engineer before the system is offered for approval.
- 70.14.3 The Contractor shall be responsible for the testing of all controls installations and shall include for liaison and attendances by specialist equipment suppliers, specialist contractors and the electrical services contractor for the testing and commissioning of mechanical and electrical elements of the complete system.
- 70.14.4 Energy management shall be considered as a prime focus of the BMS. Optimum operation of plant and equipment is clearly understood to result in reduced energy consumption and as such the contractor is directed to examine CIBSE and BSRIA Energy saving guidelines which are directly related to the commissioning and operation of the building.
- 70.14.5 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.
- 70.14.6 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 week's advance notice. The contractor shall expect that the entire system including any sub-systems will be witnessed on a point-by-point basis.

- 70.14.7 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.
- 70.14.8 On completion of system installation full testing and commissioning is to be carried out in line with CIBSE and BSRIA guidelines. Associated electrical systems testing and commissioning is to be carried out in accordance with current NSAI Wiring Regulations.
- 70.14.9 The Contractor and BMS Controls Specialist shall provide a detailed commissioning programme and shall detail all commissioning activities and time resources required to complete the BMS and HVAC systems commissioning. The Contractor shall note that completed commissioning is a requirement to achieve submission to the Building Control Authority. The BMS specialist along with the Contractor shall provide BCAR Ancillary Certification.
- 70.14.10 It is a requirement that all commissioning will be complete and test records submitted at practical completion. Diligent thorough commissioning of the BMS and Control System is an absolute requirement and all records of same shall be provided.
- 70.14.11 The Contractor and BMS 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. The BMS controls specialist shall ensure adequate resources are applied and that all such costs are included.
- 70.14.12 Prior to commissioning, the locations of all sensors in the field shall be verified and where considered necessary shall make recommendations for repositioning of sensors where it is deemed that the current position is affecting accuracy of the system.
- 70.14.13 The controls specialist shall ensure daily site attendance during the commissioning phase.
- 70.14.14 "Point to point" testing of all control points and signal cables shall be carried out by the control's specialist. Each point test shall be documented and shall be available for inspection by the Engineer upon request.
- 70.14.15 BMS commissioning shall include complete systems calibration to include, energy optimisation through thorough calibration checks on control loops, calibration checks on sensors and input devices, operational and calibration checks on actuators.
- 70.14.16 The control specialists commissioning includes review plant operation, configuration control loop PID's, setpoints, operational settings, proportional bands, system responses, calibration of sensors, operation of actuators, highlighting findings and making adjustments to ensure that plant operational efficiencies are maximised.
- 70.14.17 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.
- 70.14.18 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 three stages of commissioning and demonstrations of the system.

- 70.14.19 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 the correct operation of the system as per the Functional Descriptions of Operation.
- 70.14.20 Upon completion of Stage 1, the BMS specialist shall demonstrate the effective operation of all control loops, operation of actuators, values sensor readings and also demonstrate the accuracy of same.
- 70.14.21 The Contractor shall include for testing and calibrating all sensors verifying the accuracy of the input data. Sensor accuracy shall be verified by use of calibrated certified handheld test instrument sensors (temperature, humidity, air quality etc.). Calibration certificates for the test instruments shall be included with service reports. Offsets shall be applied to the BMS to correct any discrepancy between certified measured values and BMS indications. All programmed offsets shall be recorded and presented with service reports.
- 70.14.22 The Contractor shall include for testing and calibrating all actuators verifying the full stroke of the motor and measuring its response to the output signal. Actuator control and mechanical connections to the associated control valves or dampers shall be verified. Correct seating of the valves and dampers shall also be verified. All checks and actions shall be recorded and presented with service reports.
- 70.14.23 The Contractor shall include for “point to point” checks of all connected controls signals verifying the signal presence at the device, correct representation on the BMS controllers and accurate representation on the front-end graphics.
- 70.14.24 Commissioning shall also include trend logging of the control points to include the following.
- 70.14.25 Sensor values
- 70.14.26 Actuator positions
- 70.14.27 Meter Readings (Heat, Flow and electrical)
- 70.14.28 These trend graphs are required to be logged permanently for ongoing review and monitor the correct Calibration of Plant **Samples of graphs shall be required for approval prior to commissioning of system.**
- 70.14.29 Stage 2, being post occupancy review and adaptation to ensure that all control loops and algorithms are fully operating as expected. Where identified, any minor adjustments and “loop tuning” shall be implemented, with handover documentation and commissioning records to be updated.
- 70.14.30 The Contractor shall monitor and review plant operation, control loop PID’s, setpoints, operational settings, proportional bands, system responses, calibration of sensors, operation of actuators, highlighting findings and making adjustments to ensure that plant operational efficiencies are maximised.
- 70.14.31 Seasonal Fine-Tuning and Trend Log Analysis
- 70.14.32 The following requirements shall be incorporated into the Stage 3: Seasonal Commissioning phase:
- Quarterly Seasonal Reviews: The BMS Specialist shall attend site at three-month intervals during the first year of operation to perform seasonal adjustments to the heating and ventilation strategies.

- Room Trend Log Audit: The Specialist shall perform a comprehensive audit of room temperature and CO₂ trend logs for all principal spaces.
- Performance Verification: Using these logs, the Specialist must demonstrate that the system maintains setpoints within defined control bands (e.g. $\pm 1^{\circ}\text{C}$) without "hunting" or "overshooting" during peak summer and winter loads.
- PID Loop Optimization: The Contractor shall utilise the trend data to "fine-tune" and "loop tune" all PID algorithms, ensuring that system responses are optimized for actual building thermal mass and occupancy patterns.
- Drift Analysis: The Specialist shall compare real-time seasonal performance against the "as-installed" commissioning data; any control loop found to have drifted by 15% or more from its optimal threshold must be re-calibrated.
- Occupancy Alignment: Time schedules and occupancy-based "boost" or "trickle" ventilation settings shall be reviewed against the changing room usage logs and adjusted to maximize energy efficiency.

70.15 Labelling

- 70.15.1 Ensure that each control device has a reference label attached.
- 70.15.2 Where possible avoid placing labels on removable lids.
- 70.15.3 Contractor shall be responsible to secure permanent traffoly labels to all isolators. The label shall give a descriptive indication of the item of plant i.e. ASHP, Pumps, LTHW Pressurisation Unit, Extract Fans, AHU/HRU etc.
- 70.15.4 Labels shall be applied to all controls ancillaries to clearly identify what they are i.e. Supply Fan DPS, Panel Filter DPS, VT Temperature Sensor etc. This is intended to aid maintenance activities.
- 70.15.5 As a minimum space sensors should have a self-adhesive 'tape' type label applied to the interior of the sensor that clearly identifies the sensor location and reference in relation to the reference on the BMS graphics or user keypad. This is intended to aid building operation and maintenance activities.

70.16 Witness Testing & Demonstrations

- 70.16.1 Commissioning & Testing
- 70.16.2 Commissioning shall be conducted in three stages:
- Stage 1: Startup & Point-to-Point Verification: Includes checks of wiring, power, network topology, and full calibration of all sensors and actuators.
 - Stage 2: System Performance & Functional Testing: Includes testing sequences of operation, tuning PID loops for efficiency, and verifying all UI functions.
 - Stage 3: Seasonal Commissioning: Involves return visits during the first 12 months to fine-tune system performance in both heating and cooling seasons.
- 70.16.3 Witness Testing & Demonstration

- 70.16.4 The contractor shall include for all attendances for witness testing by the engineer. The Contractor shall provide a minimum of 10 days' notice and must provide further confirmation that all systems are ready for witness testing 24hrs before the scheduled date. Attendances must include the controls engineers who commissioned the system.
- 70.16.5 The Contractor shall verify the operation and commissioning of the completed installations and shall only invite the engineer to witness completed installations. If in the opinion of the Engineer that system commissioning is incomplete or has not been completely verified by the Contractor, the witness testing session will be cancelled. In the event of a cancelled session, the notice period for retesting will be 10days, with all associated implications to be considered by the contractor.
- 70.16.6 The Contractor shall ensure all necessary test equipment, calibrated measurement instruments, access equipment etc., is available during witness testing.
- 70.16.7 Witness testing will include random checks on sensor calibration, actuator operation, systems labelling etc.
- 70.16.8 Witness testing will also include review of system graphics and operation of the user interfaces.
- 70.16.9 The Contractor shall be expected to demonstrate trend logs, showing good control response of the system, with systems operating within control bands, without "hunting" or "overshooting". The contractor shall also demonstrate that all control functionality and spaces are operating within the required control setpoints.
- 70.16.10 The Contractor shall expect to demonstrate at least 30% of all control points, with additional testing as may be required to satisfy the engineer. Where failures or deviations are noted by the engineer, the test will be cancelled, and the contractor shall be expected to demonstrate 100% of the points in a future retest.

70.17 Training

- 70.17.1 The Contractor shall provide a minimum of 40 hours of hands-on operator training, split into an initial 8-hour session before handover and 32 hours of follow-up training to be scheduled at the Client's request.
- 70.17.2 The curriculum must cover a full system overview, software operation, scheduling, reports, and maintenance.

70.18 Handover

- 70.18.1 The Contractor and Controls Specialist shall provide a formal handover and presentation of the O&M Manuals and demonstration of the completed systems to the client and 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.
- 70.18.2 It is a requirement under BCAR that training and operational instruction is provided before submission of BCAR certification.

- 70.18.3 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.
- 70.18.4 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.

70.19 Equipment Warranties

- 70.19.1 Comprehensive Installation Warranty:
- 70.19.2 A twelve (12) month defects liability period covering the complete BMS installation. This warranty shall be fully inclusive, covering all costs for the supply, installation, programming, and commissioning of any labour, materials, and equipment required to rectify faults arising from faulty design, materials, or workmanship.
- 70.19.3 Equipment Warranty:
- 70.19.4 A minimum three (3) year manufacturer's warranty for all new control equipment and components. The Contractor shall manage all claims under this warranty on behalf of the Client.
- 70.19.5 Warranty Service Response:
- 70.19.6 A maximum twenty-four (24) hour on-site response time for all service calls placed during the warranty period.
- 70.19.7 Contractor Obligations:
- 70.19.8 The Contractor shall ensure that all servicing and maintenance are performed in strict accordance with manufacturer's instructions, guaranteeing that no action or omission invalidates the warranties provided to the Client.

70.20 Maintenance Period

- 70.20.1 The Contractor shall maintain the BMS 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.
- 70.20.2 The Contractor's proposal shall clearly stipulate all proposed maintenance requirements categorising them in terms of critical and recommended tasks. A maintenance matrix and asset register are to be included for information.
- 70.20.3 The Contractor shall include for a minimum of two maintenance visits, each of 1 day's 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 the contract. The service visits shall be scheduled to ensure primary servicing is completed before commencement with an intermediate service to be completed at a six-month interval ensuring that checks are carried out reflective of summer and winter occupancy conditions.
- 70.20.4 The Contractors personnel must be trained, competent BMS Commissioning and Maintenance staff, with senior trade's qualifications, who have a thorough understanding of Commercial, mechanical and HVAC systems. It is essential that the Contractors personnel are familiar with all legislative requirement's relating to maintenance of mechanical services and have a thorough understanding of energy efficient maintenance regimes.

- 70.20.5 The Contractor shall ensure a high level of customer support is provided and contact details and protocols for communication must be clear. Details of how the after care and support during the maintenance period will be managed are to be outlined at handover.
- 70.20.6 Service visits shall include complete system checks and replacement of defective components. The Contractor shall provide a quantity of spares for use during service visits to replace devices where the component or device is defective to this Contract.
- 70.20.7 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 and signed by the Client.
- 70.20.8 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.
- 70.20.9 The Contractor shall take cognisance of energy “benchmarks” and shall be monitored by the contractor to ensure optimal operation to ensure that the building is achieving improvements on benchmark standards.
- 70.20.10 Maintenance shall include calibration, energy optimisation through thorough calibration checks on control loops, calibration checks on sensors and input devices, operational and calibration checks on actuators.
- 70.20.11 At regular intervals and as part of the Planned Preventative Maintenance programme the Contractor shall routinely review the “as installed” commissioning data and check any drifting in system operation and performance from that data. Any elements which have been found to have drifted 15% or greater shall be re-calibrated and tested to ensure the plant or systems are operating within optimum thresholds.

70.21 Remote Monitoring

- 70.21.1 The controls specialist shall provide remote monitoring support assistance via remote connection manned from an appropriately manned support centre for a period of 12 months (maintenance period) and shall offer a support service thereafter if required by the operator.
- 70.21.2 The controls specialist will be expected to provide remote technical support and system diagnostics within four hours of receipt of an assistance call.

Mechanical Services Specification Section M70 - Appendix 1.1



Project Name
Date

RUH MH Seclusion Room Suite
21/08/2026

Rev 0

Building Management System Outline Points List

MCC Ref MCC.01

MCC Location Comms Room

The following Points List is to be read in conjunction with descriptions of operation, general arrangement drawings, system schematics and all other mechanical and electrical drawings. The Points List is illustrative of the design intent and the basis of control and operation of principle elements of the Building Automation and Control system. The Contractor shall be expected to include all necessary points as required, even where not scheduled below.

Point Reference Description	DO	DI	AO	AI	Other	Notes
Extract Fan No.1 Fan Enable	1					
Extract Fan No.1 Fan Speed			1	1		
Extract Fan No.1 Fan Common Fault		1				
Extract Fan No.2 Fan Enable	1					
Extract Fan No.2 Fan Speed			1	1		
Extract Fan No.2 Fan Common Fault		1				
Supply Fan No.1 Fan Enable	1					
Supply Fan No.1 Fan Speed			1	1		
Supply Fan No.1 Fan Common Fault		1				
Supply Fan No.2 Fan Enable	1					
Supply Fan No.2 Fan Speed			1	1		
Supply Fan No.2 Fan Common Fault		1				
Fire Smoke Damper Panel Integration and Fault		1				BACNet/Modbus
Black Bulb Temperature Sensor				2		2 per sensor
Radiant Panel Motorised Valve			1			
DX System No.1 Common Fault		1				
DX Master Controller Interface						BACNet/Modbus 2No. Internal Units Controls and Sensors
BMS Integration						
BMS Interface						
Sub Total	4	6	5	6	0	

Mechanical Services Specification Section M70 - Appendix

2.1



Project Name

RUH MH Seclusion Room Suite

Date

21/08/2026

Rev 0

Building Management System MCC Schedule

MCC Ref MCC.01

MCC Location Comms Room

The plant listed is to be served from the associated mechanical motor control centre. The control/power panels are to incorporate but should not be limited to the following switches, lamps and ancillary item as follows. The contractor shall be responsible for including any additional components which may be required to meet the intent of the specifications as outlined in the descriptions of operation

Plant Item	Switches	Lamps	Notes
Supply Fan .01	Hand/Off/Auto	Run/Trip	Green Lamp – Run Red Lamp – Trip
Supply Fan .02	Hand/Off/Auto	Run/Trip	Green Lamp – Run Red Lamp – Trip
Extract Fan EF-01	Hand/Off/Auto	Run/Trip	Green Lamp – Run Red Lamp – Trip
Extract Fan EF-02	Hand/Off/Auto	Run/Trip	Green Lamp – Run Red Lamp – Trip
DX System	Hand/Off/Auto	Run/Trip	Green Lamp – Run Red Lamp – Trip