Specification

Public Health Services Specification

ST PANCRAS COMMERCIAL CENTRE
Camden Property Holdings Ltd

CONFIDENTIAL

Revision:	T02
Description:	Stage 4 Issue
Issued:	26 March 2021
Ref:	SP003075H

Norman Disney & Young
A TETRA TECH COMPANY

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0171 GENERAL REQUIREMENTS

1 GENERAL

1.1 APPLICATION OF GENERAL REQUIREMENTS CLAUSES

General

The General Requirement clauses of this specification are supplementary to the General Conditions of Contract and in the event of any conflict or inconsistency between any of these General Requirement clauses of the specification and the General Conditions of Contract, the General Conditions of Contract prevail to the extent only of the conflict or inconsistency.

Project definitions

"Principal" means Camden Property Holdings Limited, C/O W. Real Estate Limited

"Architect" means Caruso St John (CStJ)

"Builder" means TBC

"Engineer" means Norman Disney & Young

"CxA" means independent Commissioning Authority. In the absence of an independent Commissioning Authority, then it means "Engineer".

Refer also to clause **INTERPRETATION** included in this worksection.

Project description

St Pancras Commercial Centre (St Pancras Campus) is a proposed new development located at 63 Pratt Street, Camden, London. It will comprise the following accommodation atop a common basement:

- one (1) Grade A commercial office building (basement, ground + 5 levels) providing approximately 11,000 sqm NIA of office space and approximately 3,200 m^2 NIA of a combination of retail and light industrial space;
- one (1) affordable residential building (basement, ground + 5 levels) providing approximately 1,100 m^2 of new apartments (14 apartments); and
- one (1) marketable residential building (basement, ground + 4 levels) provided approximately 1,500 m^2 of new apartments (19 apartments).

Each building is provided with separate and independent mechanical, electrical and public health (MEP) plant and services. The development must be constructed to permit future connection to a future heat network, should this become feasible in in the future.

The ground floor will incorporate building entry lobby and reception, retail units, light-industrial units, some plant areas and back-of-house areas, cycle lobby and lift, and an internal street adjacent the light-industrial and back-of-house areas. Some light-industrial units also include a mezzanine level.

A basement (lower ground) level will accommodate further plant areas, light-industrial units, circulation and end-of-trip facilities for cyclists incorporating cycle parking and storage, showers, lockers and other amenities. The light-industrial units at this level extend from ground floor units above.

Office floors will be located on levels 1 to 5. The core and building infrastructure to each floor will:

- enable levels 1–3 (inclusive) to be subdivided up to four (4) tenants per floor;
- enable levels 4–5 (inclusive) to be subdivided up to two (2) tenants per floor.

Level 6 accommodates plant areas and a public terrace and associated amenities. Plant is also located on level 7. Plant includes ventilation, cooling and heat rejection, domestic hot water services, life-safety services, communications and electrical distribution.

Vertical transportation will be provided through machine room-less lift systems.

The retail units and light-industrial units will be completed to shell and core level only.

The ground floor of the office building contains a lobby, reception desk, office working area and café. The café is partially fitted-out due to its integration with the ground floor as a whole. Light-industrial unit 05 is located on ground floor of the office building.

14 affordable apartments will be located with provision for plant on the roof and in the basement. Each apartment will be provided with power and lighting, fire protection services as required by regulations,

space heating, ventilation and domestic water services. The ground floor will incorporate entry lobby, bin stores and retail units.

19 marketable apartments will be located with provision for some plant on the roof and in the basement. Each apartment will be provided with power and lighting, fire protection services as required by regulations, space heating, ventilation and domestic water services.

A very high-quality fit and finish is required for the development. In particular, services in the commercial office building are exposed to view. The layout of services must consider symmetry, orthogonality and equal spacing. Joints must be minimised and aligned. Finishes such as paint and coatings must be factory-applied and protected through installation. Any installation not meeting this requirement must be removed and replaced. Visible components such as grilles, luminaires and fire alarm sounders and strobes are architecturally sensitive and must be strictly in accordance with the engineer's and architect's specifications.

BREEAM

Target rating: For the office building, a BREEAM 2018 UK new-construction non-domestic shell & core rating of 'Excellent'.

Responsibilities: Liaise with BREEAM assessor, understand targeted credits and complete design, installation and documentation to achieved credits, as applicable to the contract.

Conflict: The most onerous requirements of BREEAM credits or this specification applies.

Evidence of compliance: Provide in concise format.

BREEAM assessor engagement by contractor: Allow where necessary.

Lifecycle of products

Provide an Environmental Product Declaration (EPD) for:

- Heat source, space heating, air-conditioning and ventilation
- Communication, security and control systems
- Electrical Installations
- Fire and Lightning Protection
- Lift installations/systems
- Sanitary installations

Standards: To ISO 15804 Type III, ISO 14025 Type III and ISO 14024 Type I.

Alternative: Provide BRE Environmental Profile certificates.

British Council of Office Guidelines

General: Design to the requirements of the BCO Guide to Specification 2019.

Verifiable design: Required.

Validatable design: Required.

Metering

General: Comply with TM 39 Building energy metering.

Design Criteria

General: As defined in subsection **SELECTIONS** clause **SCHEDULES** subclause **Design Criteria Schedules.**

1.2 QUALITY ASSURANCE

General

Quality Assurance: Apply as required by the contract. Implement a quality system to ISO 9001, subject to external audit in accordance with BS EN 30011 and employ an Auditor accredited as an external Auditor by the United Kingdom Accreditation Services (UKAS).

All costs associated with the external audit including those of the external auditor are payable by the Contractor.

1.3 HEALTH AND SAFETY

General

Compliance: Take all steps to ensure that the obligations imposed by all Health and Safety Legislation, Acts, Regulations and Codes of Practice are complied with at all times including:

- Being familiar with the requirements of those Acts, Regulations and Codes of Practice as applicable to the works.
- Ensuring that the specified works provides for the safety of all personnel during construction, inspection, testing and subsequent operation of the system/s.
- Providing for the identification of hazards, assessment of risks, implementation of necessary risk control measures and devices and provision of information to ensure the safety of all personnel during construction, inspection, testing and subsequent operation of the system/s.
- Advising of all potential hazards not adequately protected to the requirements of the Health and Safety Legislation, Acts, Regulations and Codes of Practice.
- Providing all temporary or permanent screens, guarding, access facilities, safety notices, identification labels and safety clothing, footwear and equipment required for the execution, testing and maintenance of the works.
- Where hazardous materials are present or encountered, immediately notify the party responsible for site safety of the location and details.
- Where the Contractor is required to undertake the handling or removal of hazardous materials, the methods used shall be in accordance with accepted best industry practice and guidelines of local Authorities.

Even where the above obligations are not imposed on the Contractor by Health and Safety Legislation, the Contractor will take all steps to ensure that the obligations are complied with at all times.

Coordination: In performing its Health and Safety obligations the Contractor will coordinate with other services to ensure that notwithstanding the activities of other services, its Health and Safety Obligations are met.

1.4 FIRE SERVICE AND PROTECTION

General

Provide temporary fire fighting services and equipment in accordance with the requirements of the chief fire officer where temporary services and equipment are required, (for example when carrying out welding). Carry out welding operations in accordance with PD ISO/TR 18786.

Maintenance: Maintain the interior of all buildings so they are clear of debris including all combustible materials and liquids resulting from the performance of the works.

1.5 INTERRUPTION OF EXISTING SERVICES

General

Coordinate with occupants to make sure works are carried out at a time that either does not affect the continuity of existing services or that minimises the duration of the inconvenience to occupants.

Interruption to continuity of existing services: If work must affect or interrupt the continuity of existing services, make sure of the following:

- Obtain full written consent and approval of the affected parties, including relevant authorities.
- Provide fully approved method statements.
- Conduct at the least interruptive time as agreed by involved parties.
- Conduct so that interruption is minimised.

1.6 MAINTENANCE ACCESS REQUIREMENTS

Access provision: Provide access for maintenance to all plant, equipment and components of services that rely on maintenance to continue to perform.

Risk Assessment Method Statements (RAMS) documentation: Submit RAMS documentation for all plant and equipment provided under the contract, detailing how each component of the system will be maintained and replaced to maintain the efficiency provisions of the plant for the life of the plant. Incorporate this documentation into the Operating and Maintenance Manual.

1.7 PERMITS AND FEES

General: Conform to the requirements of authorities having jurisdiction over any part of the works including requirements for ladders, stairs, platforms, safety access, and scaffolding.

Applications: Make all applications required by any such Authority. Prepare and submit applications including those which are required to be signed by the Principal.

Payments: Pay all fees.

1.8 REQUIREMENT FOR CONTRACT

General: Make sure that there is a binding Contract in place before commencing work. The Principal is not responsible for the failure of the Contractor to enter into a contract before commencing work.

1.9 DESIGN

Design development

General: The works to be performed by the Contractor include development and finalisation of the design beyond that documented as required to complete the works.

Design by Contractor: The Contractor is required to complete the design using only appropriately qualified persons and conform to all statutory requirements. Finalise the design of the works including the design of all associated ancillary systems such as equipment support systems and seismic restraints. Undertake detailed design calculations based on the final equipment selections in accordance with the relevant technical worksections.

Conflict with the documents: If it is believed that a conflict exists between statutory requirements and the documents, notify the contract administrator immediately and provide a recommendation to resolve the conflict.

Design certification

Provide certification necessary to obtain building permits including any required registration details to the relevant authorities.

Design and build and contractor design portions

Contract type: Design and build

Development of design: Develop the design from the level of detail shown in this specification and drawings. The level of detail shown is considered suitable for tender.

Required development level: To be suitable for construction to Stage 5 in accordance with BSRIA BG6/2018.

Coordination: Coordinate with the architect, structural engineer and other designers.

Engineer qualifications: Chartered Engineers who are members of professional bodies such as CIBSE, IET, or IMechE.

Submissions: Before commencing design, submit:

- Names, appropriate qualifications, experience and registration details of persons responsible for design and certification.
- Schedule of all drawings to be produced.
- Design and installation programme.

Before commencing production of installation drawings, submit:

- Calculations of each type described below.
  - . Heating and cooling load calculations following production of a thermal model using accredited software
  - . Detailed calculations for building services requirements including duct, pipe and cable sizing and lighting levels.
  - . Calculations for fan and pump heads using equipment pressure drops based on shop drawings, and plant and equipment selected or ordered.
  - . Electrical maximum demand.
  - . Earth cable sizing.
  - . Discrimination studies .
  - . Protection grading study.
  - . Lighting levels and uniformity calculations.
  - . Lighting Guide 7 compliance calculations.
  - . Fire alarm audibility.
  - . Sprinkler coverage.
  - . Fire detection coverage.

- Single line schematics for all services including sizes and flow rates.
- Functional description of all systems submitted.

Before commencing procurement of equipment, submit:

- Layout drawings incorporating location of control elements such as space temperature sensors and switches as well as duct and equipment locations and access provisions.
- Motor Control Centre (MCC) panel drawings.
- Preparation of coordinated and dimensioned installation/fabrication and builders-work details.
- Design of support structures and bracketry, fixing systems and any proprietary products.
- Sizing and positioning of refrigerant pipework to specified criteria.
- Selection and location of 'branch control' or 'branch selector' boxes to suit the fan coil unit layout.
- Selection of acoustic attenuation to ensure 'branch control' or 'branch selector' boxes do not cause nuisance noise within the occupied space.
- Selection and sizing of all control valves and commissioning valve sets.
- Selection of acoustic attenuation.
- Technical submissions relating to all plant items.

1.10 PERFORMANCE

Corrosion resistance

General: Atmospheric corrosivity category as defined in BS EN ISO 12944-2 and BS EN ISO 9223:

Galvanizing

Severe conditions: Galvanize mild steel components (including fasteners) to BS EN ISO 14713-1 and 14713-2 and BS 7371: Part 6, if:

- Exposed to weather.
- Embedded in masonry.
- Exposed to or in air spaces behind the external leaf of masonry walls.
- In contact with chemically treated timber, other than copper chrome arsenate (CCA).

Noise levels

General: Install systems to operate within the noise level limits, as documented for the contract design and documented equipment performance.

Structure

General: If required, provide structures, installations and components as follows:

- Fixed accessways: To Building Regulations and BS 6027, BS 4211, BS 6180 and BS EN 13374.

1.11 PRECEDENCE

General

Order of precedence:

- The requirements of technical worksections of the specification override conflicting requirements of this general worksection.
- The requirements of the worksections override conflicting requirements of their referenced documents.
- The requirements of the referenced documents are minimum requirements.

1.12 CROSS REFERENCES

Cross referencing styles

Within the text:

- Worksection titles are indicated by *Italicised* text.
- Subsection titles are indicated by **BOLD** text.
- Clause titles are indicated by **BOLD** text.
- Subclause titles are indicated by **Bold** text.

1.13 REFERENCED DOCUMENTS

General

Contractual relationships: Responsibilities and duties of the principal, contractor and contract administrator are not altered by requirements in the documents referenced in this specification.

Current editions: Use referenced documents which are the editions, with amendments, current 3 months before the closing date for tenders, except where other editions or amendments are required by statutory authorities.

1.14 INTERPRETATION

Documentation conventions

Imperative mood and streamlined language: The words shall or shall be are implied where a colon is used following a keyword or within a sentence or sentence fragment.

Subject of sentences and phrases: Specification requirements are to be performed by the contractor, unless stated otherwise.

Abbreviations

General: For the purposes of this specification the following abbreviations apply:

- BCO: British Council for Offices.
- BMS: Building Management System.
- BRE: Building Research Establishment.
- BREEAM: Building Research Establishment Environmental Assessment Method.
- BS: British Standard.
- BSI: British Standards Institute.
- BSRIA: Building Services Research and Information Association.
- Cat A: A fully-functional fit-out of an office area but without furniture or customised to a tenant's requirements.
- Cat B: A fully-functional fit-out of an office area customised to the occupant's requirements including all furniture.
- CDM: Construction (Design and Management) Regulations.
- CIBSE: Chartered Institution of Building Services Engineers.
- DHW: Domestic Hot Water.
- DIN: Deutsches Institut für Normung (German Institute for Standardisation)
- EMS: Energy Management System.
- EN: European Norm (European Standard).
- FAT: Factory Acceptance Testing.
- GRP: Glass Reinforced Plastic.
- HSE: Health and Safety Executive.
- HVCA: Heating and Ventilation Contractors' Association.
- IEC: International Electro-Technical Commission.
- IET: Institution of Engineering and Technology.
- IMechE: Institution of Mechanical Engineers.
- IP: Ingress protection.
- ISO: International Standards Organisation.
- PD: Published document.
- PVC: Polyvinyl Chloride.
- uPVC: Unplasticised Polyvinyl Chloride.
- SDS: Safety data sheets.
- TM: Technical Memoranda.
- TR: Technical report.
- UKAS: United Kingdom Accreditation Service.
- VOC: Volatile Organic Compound.

- WHS: Workplace health, safety and welfare

Definitions

General: For the purposes of this specification, the following definitions apply:

- Access for maintenance: Includes access for maintenance, inspection, measurement, operation, adjustment, repair, replacement and other maintenance related tasks.
- Accessible, readily: Readily accessible, easily accessible, easy access and similar terms mean capable of being reached quickly and without climbing over or removing obstructions, using a movable ladder, and in any case not more than 2.0 m above the ground, floor or platform.
- Accredited Testing Laboratory:
  . An organisation accredited by UKAS to test in the relevant field; or
  . An organisation outside of the United Kingdom accredited to undertake the relevant tests by an authority recognised by UKAS through a mutual recognition agreement; or
  . An organisation recognised as being an Accredited Testing Laboratory under legislation at the time the test was undertaken.
- Attendance: Attendance, provide attendance and similar expressions mean give assistance for examination and testing.
- Contract administrator: Has the same meaning as architect or superintendent and is the person appointed by the owner or principal under the contract.
- Contractor: Has the same meaning as builder and is the person or organisation bound to carry out and complete the work under the contract.
- Default: Specified value, product or installation method which is to be provided unless otherwise documented.
- Design life: The period of time for which it is assumed, in the design, that an asset will be able to perform its intended purpose with only anticipated maintenance but no major repair or replacement being necessary.
- Documented: Documented, as documented and similar terms mean contained in the contract documents.
- Economic life: The period of time from the acquisition of an asset to the time when the asset, while still physically capable of fulfilling its function and with only anticipated maintenance, ceases to be the lowest cost alternative for satisfying that function.
- Electricity distributor: Any person or organisation that provides electricity from an electricity distribution system to one or more electrical installations. Includes distributor, supply authority, network operator, local network service provider, electricity retailer or electricity entity, as may be appropriate in the relevant jurisdiction.
- Geotechnical site investigation: The process of evaluating the geotechnical characteristics of the site in the context of existing or proposed construction.
- Give notice: Give notice, submit, advise, inform and similar expressions mean give notice (submit, advise, inform) in writing to the contract administrator.
- High level interface: Systems transfer information in a digital format using an open system interface.
- Hot-dip galvanized: Zinc coated to BS EN ISO 1461 after fabrication with coating thickness and mass to BS EN ISO 1461 Tables 3 and 4.
- Ingress protection: IP, IP code, IP rating and similar expression have the same meaning as IP Code in IEC 60529.
- Joints:
  . Construction joint: A joint with continuous reinforcement provided to suit construction sequence.
  . Contraction joint: An opening control joint with a bond breaking coating separating the joint surfaces to allow independent and controlled contraction of different parts or components, induced by shrinkage, temperature changes or other causes. It may include unbound dowels to assist vertical deflection control.
  . Control joint: An unreinforced joint between or within discrete elements of construction which allows for relative movement of the elements.

  - Expansion joint: A closing control joint with the joint surfaces separated by a compressible filler to allow axial movement due to thermal expansion or contraction with changes in temperature or creep. It may include unbound dowels to assist vertical deflection control.
  - Sealant joint: A joint filled with a flexible synthetic compound which adheres to surfaces within the joint to prevent the passage of dust, moisture and gases.
  - Structural control joint: A control joint (contraction, expansion and isolation) in structural elements when used with applied material and finishes.
  - Substrate joint: A joint in the substrate which includes construction joints and joints between different materials.
  - Weakened plane joint: A contraction joint created by forming a groove, extending at least one quarter the depth of the section, either by using a grooving tool, by sawing, or by inserting a premoulded strip.
- Low level interface: Systems transfer information via terminals and voltage free contacts.
- Manufacturer's recommendations: Recommendations, instructions, requirements, specifications (and similar expressions) provided in written or other form by the manufacturer and/or supplier relating to the suitability, use, installation, storage and/or handling of a product.
- Metallic-coated: Steel coated with zinc or aluminium-zinc alloy to BS EN ISO 1461, BS EN ISO 14713-1, BS EN ISO 14713-2, BS 7371: Part 6, BS EN 10244: Part 2, BS EN 10346 and BS 3083.
- Network Utility Operator: The entity undertaking the piped distribution of drinking water or natural gas for supply or is the operator of a sewerage system or external stormwater drainage system.
- Obtain: Obtain, seek and similar expressions mean obtain (seek) in writing from the contract administrator.
- Pipe: Includes pipe and tube.
- Practical completion or defects free completion: The requirements for these stages of completion are defined in the relevant building contract for the project.
- Principal: Principal has the same meaning as owner, client and proprietor and is the party to whom the contractor is legally bound to construct the works.
- Proprietary: Identifiable by naming the manufacturer, supplier, installer, trade name, brand name, catalogue or reference number.
- Prototype: A full size mock-up of components, systems or elements to demonstrate or test construction methods, junctions and finishes, and to define the level of quality.
- Provide: Provide and similar expressions mean supply and install and include development of the design beyond that documented.
- Record drawings: Record drawings has the same meaning as as-installed drawings, as-built drawings and work-as-executed drawings.
- Referenced documents: Standards and other documents whose requirements are included in this specification by reference.
- Required: Required by the contract documents, the local or statutory authorities.
- If required: A conditional specification term for work which may be shown in the documents or is a legislative requirement.
- Sample: A physical example that illustrates workmanship, materials or equipment, and establishes standards by which the work will be judged. It includes samples and sample panels.
- Statutory authority: A public sector entity created by legislation, that is, a specific law of the United Kingdom.
- Sub-Contractor: Is the person or organisation who takes on a portion of a contract under the Principal Contractor or from another Sub-Contractor.
- Supply: Supply, furnish and similar expressions mean supply only.
- Tests – completion: Tests carried out on completed installations or systems and fully resolved before the date for practical completion, to demonstrate that the installation or system, including components, controls and equipment, operates correctly, safely and efficiently, and meets performance and other requirements. The superintendent may direct that completion tests be carried out after the date for practical completion.
- Tests – pre-completion: Tests carried out before completion tests, including:

  . Production: Tests carried out on a purchased item, before delivery to the site.
  . Progressive: Tests carried out during installation to demonstrate performance in conformance with this specification.
  . Site: Tests carried out on site.
  . Type: Tests carried out on an item identical with a production item, before delivery to the site.
  . Tolerance: The permitted difference between the upper limit and the lower limit of dimension, value or quantity.
- Utility service provider: Includes organisations providing power, water, sewerage, gas and telecommunications services.
- Verification: Provision of evidence or proof that a performance requirement has been met or a default exists.

1.15 CONTRACT DOCUMENTS

Services diagrammatic layouts

General: Layouts of service lines, plant and equipment shown on the drawings are diagrammatic only, except where figured dimensions are provided or calculable.

Before commencing work:

- Obtain measurements and other necessary information.
- Coordinate the design and installation in conjunction with all trades.

Levels

General: Spot levels take precedence over contour lines and ground profile lines.

Drawings and manuals for existing services

Subsurface services: Information shown on the drawings relating to underground or submerged services must be accurate to the following quality level:

- Quality level: QL-A to BSI PAS 128

Warranty: No warranty is given as to the completeness or accuracy of drawings and/or manuals of existing services.

1.16 SUBMISSIONS

General

Default timing: Make submissions to the Contract Administrator at least 5 working days before ordering products or starting installation of the respective portion of the works.

Proposed product schedules: If major products are not specified as proprietary items, submit a schedule of those proposed for use to the Contract Administrator within 3 weeks of site possession.

Requirement

General: Submit the following:

- Authority approvals: Notes of meetings with authorities whose requirements apply to the work and evidence that notices, fees and permits have been sought and paid, that authority connections are complete and that statutory approvals by the authorities whose requirements apply to the work have been received.
- Building penetrations: Details of the methods to maintain the required structural, fire and other properties to worksection *0171 General requirements* subsection **EXECUTION** Clause **BUILDING PENETRATIONS.**
- Certification: Certification of conformance to documented requirements, including certification that the plant and equipment submitted meets all requirements of the contract documents and that each installation is operating correctly.
- Design documentation: Design data and certification of proposed work, if required and as documented.
- Electronic facility and asset management information: For the whole of the work to **EXECUTION**, **ELECTRONIC FACILITY AND ASSET MANAGEMENT INFORMATION**.
- Execution details: Execution programs, schedules and details of proposed methods and equipment. For building services include the following:
  . Embedded services: Proposed method for embedding services in concrete walls or floors or chasing into concrete or masonry walls.

  - . Fixing of services: Typical details of locations, types and methods of fixing services to the building structure.
  - . Inaccessible services: If services will be enclosed and not accessible after completion, submit proposals for location of service runs and fittings.
- Fire performance: Evidence of conformity to requirement for combustibility, fire hazard properties and fire-resistance of building elements.
- Marking and labelling: Samples and schedules of proposed marking and labels to **EXECUTION**, **MARKING AND LABELLING.**
- Operation and maintenance manuals: For the whole of the work to **EXECUTION**, **OPERATION AND MAINTENANCE MANUALS**.
- Products: Products and materials data, including manufacturer's technical specifications and drawings, SDS for hazardous materials, type tests results, evidence of conformity to documented requirements, product certification, performance and rating tables, service connection requirements and installation and maintenance recommendations.
- Prototypes: Prototypes of components, systems or elements.
- Records: As-built documents, photographs, system diagrams, schedules and logbooks to subsection **EXECUTION** clause **RECORD DRAWINGS**.
- Samples: Representative of proposed products and materials and including proposals to incorporate samples into the works, if any, to subsection **EXECUTION** clause **SAMPLES**.

Shop drawings: To subsection **EXECUTION** clause **SHOP DRAWINGS**.

- Substitutions: To subsection **PRODUCTS** clause **GENERAL** subclause **Substitutions**.
- Tests:
  - . Inspection and testing plan consistent with the construction program including details of test stages and procedures.
  - . Certificates for type tests.
  - . Fire hazard properties: Evidence of conformance of proposed proprietary products to documented requirements for fire hazard properties.
  - . Test reports for testing performed under the contract to subsection **EXECUTION** clause **TESTS**.
- Warranties: To subsection **EXECUTION** clause **WARRANTIES**.
- Contractor review: Before submissions, review each submission item and check for coordination with other work of the contract and conformance to contract documents.

Submit to: Contract Administrator.

Submission times

Default timing: Make submissions at least 5 working days before ordering products or starting installation of the respective portion of the works.

Submission response times: Allow in the construction program for at least the following times:

- Shop drawings: 2 weeks
- Samples and prototypes: 2 weeks
- Manufacturers' or suppliers' recommendations: 2 weeks
- Product data: 2 weeks
- Product/design substitution or modification: 2 weeks

Proposed products schedules: If major products are not specified as proprietary items, submit a schedule of those proposed for use within 3 weeks of site possession.

Submission review

Default timing: Shop drawings and technical data will be reviewed, marked where alterations are desired and returned within 14 working days of receipt, unless specified elsewhere.

Review status: Submissions will be submitted with one of the following statuses:

Action A: Drawing or technical data returned with no comments. The Contractor may proceed with the works based on the details depicted on the drawing or technical data.

Action B: Drawing or technical data returned with comments. The Contractor may proceed with the works provided that the comments are incorporated into the works. Revise drawings and technical data to incorporate comments and resubmit within 14 days.

Action C: The drawing or technical data is not accepted and is returned with comments. The Contractor may not proceed with the works. Revise drawings and technical data to incorporate comments and resubmit.

Certificate of compliance

Format: Provide in a format as required and as agreed with the Contract Administrator .

Frequency: Provide a certificate of compliance for the installation monthly or otherwise as agreed with the Contract Administrator. Submit the Certificate of Compliance to the Contract Administrator and, when directed, submit to the Engineer.

Content: Include a list of all the relevant design documents (Document Schedule) including:

- Specifications.
- Drawings.
- Subsequent instructions.

Confirm the work undertaken, being the systems and items of plant included in the design documents, and certify that the work is complete and is in accordance with the documents listed in the Document Schedule, except where specifically stated in a non-compliance schedule accompanying the Certificate of Compliance.

List all departures from the design: Attach a non-compliance schedule to the Certificate of Compliance listing all departures.

Identification

Requirement: Identify the project, contractor, subcontractor or supplier, manufacturer, applicable product, model number and options, as appropriate and include relevant contract document references. Include service connection requirements and product certification.

Non-conformance: Identify proposals that do not conform with project requirements, and characteristics which may be detrimental to successful performance of the completed work.

Errors

Errors: If a submission contains errors, make a new or amended submission as appropriate, indicating changes made since the previous submission.

Electronic submissions

Electronic copies file format: Unsecured PDF and original production format.

Transmission medium: Digital delivery via email or project portal.

Submission medium: Unsecured PDF.

Delivery method: Use project digital transfer process.

Hard copy submissions: Not accepted

Drawing size: ISO 216 A or B series.

Standards: BSRIA BG 6/2018 - A Design Framework for Building Services and BS 8888 as applicable.

Access

General: Submit locations and sizes of access openings required for the installation, service and adjustment of equipment, including access panels to pitot traverse stations.

Vibration isolation

Submit a schedule of all vibration isolators showing:

- Manufacturer and model
- Type.
- Loading.
- Static deflection.
- Surge frequency.
- Height/diameter ratio when loaded.
- Percentage deflection when loaded.
- Other data used to determine performance.

Maintenance schedule

Maintenance schedule: Prior to commencement of the defects liability period, submit a maintenance schedule for appraisal, setting out maintenance procedures and frequencies to ensure trouble free

operation and plant operating efficiency. Include the maintenance schedule in the operation and maintenance manual.

1.17 FACTORY ACCEPTANCE TESTING

General: Required for:

- 4-pipe heat pump/chillers for the commercial office building

Test location: Manufacturer's test facility

Witnesses: Both the Principal's representative and the Engineer or as otherwise agreed.

Location: Advise.

Notice: At least 7 days prior. 30 days if location is outside the United Kingdom.

Costs: Fund all accommodation, transport and meals for the witnesses.

Labour, equipment and supplies: Provide.

Testing equipment and rig: Set up prior to arrival of witnesses.

Prior testing: Complete prior to arrival of witnesses.

Testing method statements: Provide 30 days prior.

- Commercial building reception in-floor supply air grilles with architectural over-grille; minimum requirements:
    - BS EN ISO 7730 test for air speed and proximity across an array of at least 3x3 diffusers with additional smoke test for visual imaging if not included within
    - Acoustic test
    - Pressure drop
    - Throw / airflow pattern

Test location: Manufacturer's test facility

Witnesses: Both the Principal's representative and the Engineer or as otherwise agreed.

Location: Advise.

Notice: At least 7 days prior. 30 days if location is outside the United Kingdom.

Costs: Fund all accommodation, transport and meals for the witnesses.

Labour, equipment and supplies: Provide.

Testing equipment and rig: Set up prior to arrival of witnesses.

Prior testing: Complete prior to arrival of witnesses.

Testing method statements: Provide 30 days prior.

1.18 INSPECTION

Notice

Concealment: If notice of inspection is required for parts of the works that are to be concealed, advise when the inspection can be made before concealment.

Tests: Give notice of the time and place of documented tests.

Minimum notice: 5 working days.

Light levels

Requirements: To BS EN 12464.

Attendance

General: Provide attendance for documented inspections and tests.

Minimum notice: 5 working days.

2 PRODUCTS

2.1 MATERIALS AND COMPONENTS

Manufacturers' or suppliers' recommendations

General: Provide and select, if no selection is given, transport, deliver, store, handle, protect, finish, adjust and prepare for use the manufactured items to the manufacturers' or suppliers' recommendations.

Proprietary items/systems/assemblies: Assemble, install or fix to substrate to the manufacturers' or suppliers' recommendations.

Project modifications: Advise of activities that supplement, or are contrary to the manufacturers' or suppliers' recommendations.

Product identification

Sealed containers: If materials or products are supplied by the manufacturer in closed or sealed containers or packages, bring the materials or products to point of use in the original containers or packages.

Other products: Marked to show the following, as applicable:

- Manufacturer's identification.
- Product brand name.
- Product type.
- Quantity.
- Product reference code and batch number.
- Date of manufacture.

Consistency

General: For each material or product use the same source or manufacturer and provide consistent type, size, quality and appearance.

Prohibited materials

General: Do not provide the following:

- Materials, exceeding the limits of those listed, in the Control of Substances Hazardous to Health (COSHH) regulations.
- Materials that use chlorofluorocarbon (CFC) or hydrochlorofluorocarbon (HCFC) in the manufacturing process.

Substitutions

Identified proprietary items: Identification of a proprietary item does not necessarily imply exclusive preference for the identified item, but indicates the necessary properties of the item.

Alternatives: If alternatives to the documented products, methods or systems are proposed, submit sufficient information to permit evaluation of the proposed alternatives, including the following:

- Evidence that the performance is equal to or greater than that specified.
- Evidence of conformity to a cited standard.
- Samples.
- Essential technical information, in English.
- Reasons for the proposed substitutions.
- Statement of the extent of revisions to the contract documents.
- Statement of the extent of revisions to the construction program.
- Statement of cost implications including costs outside the contract.
- Statement of consequent alterations to other parts of the works.

Availability: If the documented products or systems are unavailable within the time constraints of the construction program, submit evidence.

Criteria: If the substitution is for any reason other than unavailability, submit evidence that the substitution:

- Is of net enhanced value to the principal.
- Is consistent with the contract documents and is as effective as the identified item, detail or method.

Galvanizing
Conditions: Galvanize mild steel components (including fasteners) to BS EN ISO 14713-1 and 14713-2 and BS 7371: Part 6, if:

- Exposed to weather.
- Embedded in masonry.
- Exposed to or in air spaces behind the external leaf of masonry walls.
- In contact with chemically treated timber, other than copper chrome arsenate (CCA).

Zero insulant ozone depleting potential
General: Provide insulates as part of the works that minimize the use of ozone depleting substances in both manufacture and composition.

Insulation types: Where insulation types have been nominated elsewhere within this specification and they do not meet the above criteria provide an alternative insulation with similar properties for minimizing ozone depleting potential.

Low volatile organic compound paints, sealants and adhesives
General: Provide all paints, adhesives and sealants with a low VOC content that is equal to or less than 50 g/L.

2.2 ELECTROMAGNETIC COMPATIBILITY FRAMEWORK COMPLIANCE

General
General: Ensure that all electrical, electronic and digital components and systems provided as part of the Works, meet the requirements of the Electromagnetic Compatibility Regulations to prevent Electromagnetic Interference (EMI). Conform to BS EN 61000, relevant to the products and where required are labelled with the CE mark to establish compliance with the regulations.

2.3 ELECTROMAGNETIC COMPATIBILITY (EMC) LIMITS

General
General: Complete and submit to the Engineer within two weeks of award of contract and prior to placement of equipment orders, full electrical characteristics. to facilitate an accurate evaluation of flicker emissions, for all electrical equipment of 200 kW maximum energy consumption and greater.

2.4 HARMONIC PERFORMANCE OF EQUIPMENT

General
General: Select all electrical, electronic and digital components and systems, provided as part of the works, on the basis of and/or supply with additional harmonic reduction equipment to conform to the maximum harmonic current distortion as detailed below.

Harmonic current: At the location of the installed equipment or Point of Common Coupling (PCC as defined below), the upstream harmonic current is to conform to the prescribed harmonic current distortion limits as detailed in IEEE Standard 519 ‘Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems’, replicated below:

I_{SC} / I_L	**Maximum harmonic current distortion in percent of I_L**					**TDD***
	Individual harmonic order ‘h’ (odd harmonics)					
	<11	**11≤h<17**	**17≤h<23**	**23≤h<35**	**35≤h**	
<20*	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12.0
100<1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

Even harmonics are limited to 25% of the odd harmonic limits above.
*Total demand distortion based on harmonic current distortion in % of I_L.
Current distortions that result in a dc offset, e.g., half wave converters, are not allowed.
*All power generation equipment is limited to these values of current distortion regardless of actual I_{SC}/I_L.

Where:
I_{SC} = maximum short circuit current at point of common coupling.
I_L = maximum demand load current (fundamental frequency component) of equipment or sum of equipment/system where more than one item of equipment is connected to the same PCC.
Do not include other non harmonic current producing equipment connected to the PCC in determining I_L.

The point of common coupling: Is defined as the nearest point on the electrical system where another item of equipment, existing/new or future, supplied by the Contractor or other Services Contractor, is or can be connected to the same electrical supply as the item or system in question. Examples of the point of common coupling are mechanical services switchboards, control panels, hydraulic services control panels, lift services switchboards, distribution boards and the like. Where the Contractor is unclear as to the point of common coupling, seek clarification from the Engineer.

Test: Demonstrate the installation is in compliance with the above prescribed maximum harmonic current distortion limits during commissioning and at full load. The Contractor is to allow for all test equipment capable of measuring up to the 50th harmonic. Submit to the Engineer a certified hard copy of the test results.

3 EXECUTION

3.1 SAMPLES

General

Incorporation of samples: Only incorporate samples in the works which have been endorsed for inclusion. Do not incorporate other samples.

Retention of samples: Keep endorsed samples in good condition on site, until the date of practical completion.

Unincorporated samples: Remove on completion.

3.2 SHOP DRAWINGS

General

Documentation: Include dimensioned drawings showing details of the fabrication and installation of structural elements, building components, services and equipment, including relationship to building structure and other services, cable type and size, and marking details.

Diagrammatic layouts: Coordinate work shown diagrammatically in the contract documents, and prepare dimensioned set-out drawings.

Services coordination: Coordinate with other building and service elements. Show adjusted positions on the shop drawings.

Space requirements: Check space and access for maintenance requirements of equipment and services indicated diagrammatically in the contract documents.

Building work drawings for building services: On dimensioned drawings show the following:

- Access doors and panels.
- Conduits to be cast in slabs.
- Holding down bolts and other anchorage and/or fixings required complete with loads to be imposed on the structure during installation and operation.
- Openings, penetrations and block-outs.
- Sleeves.
- Plinths, kerbs and bases.
- Required external openings.

Submission medium: Electronic only.

Record drawings: Amend all documented shop drawings to include changes made during the progress of the work and up to the end of the defects liability period.

3.3 OFF-SITE DISPOSAL

Removal of material
General: Dispose of building waste material off site to the requirements of the relevant authorities.

3.4 WALL CHASING

Holes and chases
General: If holes and chases are required in masonry walls, make sure structural integrity of the wall is maintained. Do not chase walls nominated as fire-resistance or acoustic rated.

Parallel chases or recesses on opposite faces of a wall: Not closer than 600 mm to each other.

Chasing in blockwork: Only in core-filled hollow blocks or in solid blocks which are not designated as structural.

Concrete blockwork chasing table

Block thickness (mm)	Depth of chase (maximum mm)
190	35
140	25
90	20

3.5 FIXING

General
Suitability: If equipment is not suitable for fixing to non-structural building elements, fix directly to structure and trim around penetrations in non-structural elements.

Application: Provide fixings for equipment and wiring for securing to walls, ceilings, floors or structure as applicable. Provide fixings of an approved type and pattern

Nuts and bolts: Provide nuts and bolts as follows:

- Having hexagonal heads.
- Include washers.
- Have metric threads.
- Be of a length that, when tightened to correct tension, will show at least one full thread beyond the nut.

Holes: Neatly form all fixings holes in concrete or brickwork to a depth equal to the length of the plug to be used, excluding plaster or other soft cladding finish. Do not fix into joints between bricks or blockwork.

Load bearing: Provide load bearing fixings of an appropriate size to support the anticipated load plus a 50% safety factor. Provide corrosion resistant fixings of the same or of a more noble material to suit their installed location to avoid preferential corrosion.

Fixings that rely on a propellant system: Use fixings that rely on a propellant system such as gas or air pressure subject to:

- Conformance with the manufacturer's installation methods.
- The extent of damage to building substrates and the capability to remove fixings and make good substrates that are equivalent to drilled fixings.

Unacceptable fixings
The following fixings are not acceptable:

- Fixings made by the use of explosive powered tools.
- Fixings made in the mortar joint in block or brickwork.
- Fixings made into the timber infills of concrete slab floors.
- Fixings into plasterboard, fibre cement, ceiling tiles or similar friable material.
- Fixings into basins, tanks and the like.
- Fixings that rely on adhesives.
- Self tapping screws into sheet metal.
- Nails.

- Fixings that rely on expanding elements of nylon, plastics or similar synthetic material for wiring and equipment associated with emergency systems.
- Nylon ties for all power sub mains and feeders except where they are run in horizontal plane and the weight of submains is directly supported by a cable tray or ladder rack

Materials

Internal or low corrosion risk: Electro galvanised.

Exposed to weather: Hot dip galvanised or stainless steel.

In corrosive atmospheres: Stainless steel.

Exposed to weather within 5km of coastal regions: Stainless steel

Fasteners

General: Use proprietary fasteners capable of transmitting the loads imposed, and sufficient for the rigidity of the assembly.

3.6 SERVICES CONNECTIONS

Connections

General: Connect to network distributor services or service points. Excavate to locate and expose connection points. Reinstate the surfaces and facilities that have been disturbed.

Utility service provider requirements

General: If the utility service provider elects to perform or supply part of the works, make the necessary arrangements. Install equipment supplied, but not installed, by the Utility service provider.

3.7 SERVICES INSTALLATION

General

Fixing: If non-structural building elements are not suitable for fixing services to, fix directly to structure and trim around penetrations in non-structural elements.

Installation: Install equipment and services as follows:

- Plumb and securely fixed.
- Allow for movement in both structure and services.
- Arrange services running together, parallel to each other and adjacent building elements.

Concealment: Conceal all cables, ducts, trays and pipes except where installed in plant spaces, ceiling spaces and riser cupboards or documented to be exposed. If alternative routes are available, do not locate on external walls.

Lifting: Provide heavy items of equipment with permanent fixtures for lifting to the manufacturer's recommendations.

Suspended ground floors: Keep all parts of services suspended under ground floors at least 150 mm clear of the ground surface. Make sure services do not impede access.

Dissimilar metals

Joining: Join dissimilar metals with fittings of electrolytically compatible material.

Temporary capping

Pipe ends: During construction protect open ends of pipe with metal or plastic covers or caps.

Piping

General: Install piping in straight lines at uniform grades without sags. Arrange to prevent air locks. Provide sufficient unions, flanges and isolating valves to allow removal of piping and fittings for maintenance or replacement of plant.

Spacing: Provide at least 25 mm clear between pipes and between pipes and building elements, additional to insulation.

Changes of direction: Provide as follows:

- If practicable, long radius elbows or bends and sets, and swept branch connections.
- If pipes are led up or along walls and then through to fixtures, provide elbows or short radius bends.
- Do not provide mitred fittings.

Vibration: Arrange and support piping to prevent vibration whilst permitting necessary movement. Minimise the number of joints.

Embedded pipes: Do not embed pipes that operate under pressure in concrete or surfacing material.

Valve groupings: If possible, locate valves in groups.

Pressure testing precautions: Isolate items not rated for the test pressure. Restrain pipes and equipment to prevent movement during pressure testing.

Support and structure

Requirement: Provide incidental supports and structures to suit the services.

Pipe support systems

General: Provide proprietary support systems of metallic-coated steel construction.

Vertical pipes: Provide anchors and guides to maintain long pipes in position, and supports designed for the mass of the pipe and its contents.

Saddles: Provide saddle supports only on DN 25 or smaller pipes.

Dissimilar metals: If pipe and support materials are dissimilar, provide industrial grade electrically non-conductive material securely bonded to the pipe to separate them. Provide fasteners of electrolytically compatible material.

Uninsulated pipes: Clamp piping supports directly to pipes.

Insulated pipes:

- Spacers: Provide spacers at least as thick as the insulation between piping supports and pipes. Extend either side of the support by at least 20 mm.
- Spacer material: Rigid insulation material of sufficient strength to support the piping and suitable for the temperature application.

Support spacing: As follows:

- Cold and heated water pipes: To BS EN 806 series.

Sanitary plumbing: To BS EN 12056-2.

Fuel gas: To IGEM-UP2

Hanger size table

Nominal pipe size (DN)	**Minimum hanger diameter for single hangers (mm)**
50 maximum	9.5
65 to 90	12.7
100 to 125	15.8
150 to 200	19.0

Differential movement

General: If the geotechnical site investigation report predicts differential movements between buildings and the ground in which pipes or conduits are buried, provide control joints in the pipes or conduits, as follows:

- Arrangement: Arrange pipes and conduits to minimise the number of control joints.
- Magnitude: Accommodate the predicted movements.

3.8 BUILDING PENETRATIONS

Penetrations

Requirement: Maintain the required structural integrity, fire performance, water proofing performance and other properties when penetrating or fixing to the following:

- Structural building elements including external walls, fire walls, fire doors and access panels, other tested and rated assemblies or elements, floor slabs and beams.
- Membrane elements including damp-proof courses, waterproofing membranes and roof coverings. If penetrating membranes, provide a waterproof seal between the membrane and the penetrating component.

Sealing

Fire-resisting rated building elements: Seal penetrations with a system conforming to Approved Document B.

Non fire-resisting building elements: Seal penetrations around conduits and sleeves. Seal around cables within sleeves. If the building element is acoustically rated, maintain the rating.

Sleeves

General: If piping, cables or conduit penetrates building elements, provide metal or uPVC sleeves formed from pipe sections as follows:

- Movement: Arrange to permit normal pipe or conduit movement.
- Diameter (for non-fire-resisting rated building elements): Sufficient to provide an annular space around the pipe or pipe insulation of at least 12 mm.
- Prime paint ferrous surfaces.
- Terminations:
  . Cover plates fitted: Flush with the finished building surface.
  . Fire-resisting and acoustic-rated building elements: 50 mm beyond finished building surface.
  . Floors draining to floor wastes: 100 mm above finished floor.
  . Plantroom floors: 100 mm above finished floor.
  . Other locations: 5 mm beyond finished building surface.
- Thickness:
  . Metal: 1 mm or greater.
  . Galvanised steel 1.2mm or thicker
  . uPVC: 3 mm or greater.

Sleeves for cables: For penetrations of cables not enclosed in conduit through ground floor slabs, beams and external walls provide sleeves formed from uPVC pipe sections.

Holes not built-in

Cutting: Drill or cut out where they have not been provided during construction of the building element.

3.9 CONCRETE PLINTHS

Construction

Height: Minimum 100mm or greater as documented.

Surround: Provide galvanized steel surround at least 100 mm high and 1.6 mm thick or greater as documented. Fix to the floor with masonry anchors.

Reinforcement & Concrete Fill: Provide reinforcement and fill with concrete in accordance with the Structural Engineer approved design.

Finish: Steel float flush with surround.

3.10 EQUIPMENT SUPPORT AND STRUCTURE

General

For the effective location and mounting of equipment.

General arrangement and details as documented.

- As determined by a qualified Structural Engineer.
- Base height to suit the equipment operation needs and adequacy of drainage. Where equipment needs to be elevated for drainage or other purposes, check dimensions nominated and make such changes as are necessary to ensure satisfactory installation of equipment. Minimum base height is 100 mm.
- Waterproof membrane, to detail by a qualified Structural Engineer, to secure areas subject to drainage against water penetration.
- Drain pipe connection incorporating a puddle flange in the concrete base having a minimum diameter of 3 times drain pipe OD.
- Provision of thermal insulation and/or vibration isolation.
- Base perimeter extending 75 mm beyond the extremities of the equipment. Surfaces shaped and graded for drainage where required and edges rounded or bevelled.
- Vibration isolated inertia block to the requirements of worksection 0171 General requirements subsection **EXECUTION** clauses **VIBRATION SUPPRESSION** and clause **NOISE CONTROL**.
- Holding down bolts in equipment bases, checked and confirmed on site to ensure correct positioning.

Where others are identified to provide equipment bases, provide detailed dimension drawings and adequate site supervision to ensure the bases are installed in accordance with the requirements.

Requirement: Provide incidental supports and structures to suit the services.

3.11 PLANT AND EQUIPMENT

General

Location: Locate so that failure of plant and equipment (including leaks) does not create a hazard for the building occupants and causes minimum or no damage to the building, its finishes and contents including water sensitive equipment or finishes.

Drip tray and overflow pipe: Provide to each tank, hot water heater and storage vessel where not in drained plantroom areas.

3.12 ACCESS FOR MAINTENANCE

General

Requirement: Provide access for maintenance of plant and equipment.

Standards: Conform to the relevant requirements of BS 6037.

Work Health and Safety: Conform to the requirements of the applicable Workplace health, safety and welfare regulations

Protection from injury: Protect personnel from injury caused by contact with objects including those that are sharp, hot or protrude at low level.

Plant room flooring surfaces: R10 Slip resistance classification to DIN 51130

Trip hazards: Do not run small services including drains and conduits across floors where they may be a trip hazard.

Manufacturer's standard equipment: Modify manufacturer’s standard equipment when necessary to provide the plant access documented.

Clearances

Minimum clearances for access: If not defined in regulations or standards either documented or mandatory, conform to the following:

- Vertical clearance: ≥ 2100 mm clear vertically above horizontal floors, ground and platforms.
- Horizontal clearance: Preferably ≥ 750 mm clear, but in no case less than 600 mm horizontally between equipment or between equipment and building features including walls.
- If tools are required to operate, adjust or remove equipment, provide sufficient space so that the tools can be used in their normal manner and without requiring the user to employ undue or awkward force.
- If equipment components are hinged or removable, allow the space recommended by the manufacturer.
- Within plant items: Conform to the preceding requirements, and in no case less than the clearances recommended in BS 8313.

Elevated services other than in occupied areas

Access classifications:

- Access class A: Readily accessible. Provide clear and immediate access to and around plant items. If plant or equipment is located more than 2.0 m above the ground, floor or platform, provide a platform with handrails accessible by a stair.
- Access class B: If the plant item requiring access is located more than 2.0 m above the ground, floor or platform, provide a platform with handrails accessible by a non-vertical ladder..
- Access class C: Locate plant so that temporary means of access conforming to Workplace health, safety and welfare regulations can be provided.
- Temporary means of access: Make sure there is adequate provision in place which is safe and effective.

Areas in which access is restricted to authorised maintenance personnel: Provide access as follows:

- Instruments, gauges and indicators (including warning and indicating lights) requiring inspection at any frequency: Readily accessible.
- Access required monthly or more frequently: Access class A.

- Access required between monthly and six monthly: Access class A or B.
- Access required less frequently than six monthly: Access class A, B or C.

Other areas: Provide access as follows:

- Locate to minimise inconvenience and disruption to building occupants or damage to the building structure or finishes.
- In suspended ceilings, locate items of equipment that require inspection and/or maintenance above tiled parts. If not possible, provide access panels where located above set plaster or other inaccessible ceilings. Arrange services and plant locations to reduce the number of access panels. Coordinate with other trades to use common access panels where feasible.
- Do not locate equipment requiring access above partitions.
- Instruments, gauges and other items requiring inspection at any frequency: Readily accessible.
- Labelling: If equipment is concealed in ceilings, provide marking to clause **MARKING AND LABELLING** subclause **Equipment concealed in ceilings**.

Facilities for equipment removal and replacement

Requirement: Provide facilities to permit removal from the building and replacement of plant and equipment, including space large enough to accommodate it and any required lifting and/or transportation equipment. Arrange plant so that large and/or heavy items can be moved with the minimum of changes of direction.

Removal of components: Allow sufficient space for removal and replacement of equipment components including air filters, tubes of shell and tube heat exchangers, removable heat exchanger bundles, coils and fan shafts. Provide access panels or doors large enough to permit the safe removal and replacement of components within air handling units.

Chain blocks and trolleys

General: Monorails are required over:

- Chiller motors water box covers and connecting pipework on chillers 500 TR and larger. Note that pipework layout must suit monorail, otherwise use eye bolts
- Above access openings provided for handling equipment, down to lifts.

Positions and loadings of monorails: Where monorails are required, provide within reasonable time, drawings and information setting out positions and loadings for the monorails.

Chain blocks: Provide chain blocks with a load brake mechanism and case hardened gears mounted in a robust steel case, high tensile steel chain, shielded ball bearings and forged steel hook.

Push type trolleys: Provide push type trolleys and make sure the entire assembly operates at the maximum load rating by a chain effort of not more than 35 kg.

Chain block assemblies: Provide chain block assemblies to approval by the Statutory Authorities.

Eye bolts

General: Provide within reasonable time, drawings and information setting out positions and loadings for eye bolts to be provided for servicing equipment.

Facilities for access

Equipment behind hinged doors: Provide doors opening at least 150°.

Equipment behind removable panels: Provide panels with quick release fasteners or captive metal thread screws.

Removable panels: Provide handles to permit easy and safe removal and replacement.

Insulated plant and services: If insulation must be removed to access plant and services provide access for maintenance, arranged so it can be repeatedly removed and replaced without damage.

Piping, conduits & cable trays

Requirement: Conform to the following:

- Provide access and clearance at fittings which require maintenance, inspection or servicing, including control valves and joints intended to permit pipe removal.
- Arrange piping so that it does not interfere with the removal or servicing of associated equipment or valves or block access or ventilation openings.
- Preferably run piping, conduits, cable trays and ducts at high level and drop vertically to equipment.

Electrical equipment and controls

Requirement: Provide clearances and access space to BS 7671.

Switchboards and electrical control equipment: Locate near the main entrance to plant space. Arrange plant so that, to the greatest extent possible, switchboards are visible from the plant being operated.

Control panels: Locate near and visible from the plant controlled.

3.13 VIBRATION SUPPRESSION

General

Requirement: Minimise the transmission of vibration from rotating or reciprocating equipment to other building elements.

Balancing: Statically and dynamically balance all equipment to reduce vibration at source.

Vibration induced noise: Rectify rattles and vibration induced noise, which are generated by the system and which are determined to be a potential source of annoyance to occupants.

Design: Assess vibration requirements and provide vibration isolation as required to conform to BS ISO 2017-1

Standard

Machinery noise and vibration: Vibration severity in Zone A to ISO 20816-1 and ISO 10816-3.

Speeds

General: If no maximum speed is prescribed do not exceed 1500 r/min for direct driven equipment.

Design: Assess vibration requirements and provide vibration isolation as required to conform to ISO 2017-2.

Connections

General: Provide flexible connections to rotating machinery and assemblies containing rotating machinery. Isolate pipes by incorporating sufficient flexibility into the pipework.

- Exception: Do not use flexible couplings on pumps.

Inertia bases

General: If necessary to achieve the required level of vibration isolation, provide inertia bases having appropriate mass and conforming as follows:

- Construction: Steel or steel-framed reinforced concrete. Position foundation bolts for equipment before pouring concrete.
- Supports: Support on vibration isolation mountings using height saving support brackets.
- Inertia base to be concrete in a steel frame, at least 1.5 times the weight of the equipment.
- Do not remove equipment from and manufacturers base, but ensure that the manufacturer’s base is rigidly fixed to the inertia base to minimise deflection of either base.

Cables and ancillaries

General: Make sure the connection of electrical cables, instrumentation and gauge lines to vibrating equipment are sufficiently flexible to prevent undue transmission of vibration.

Connection to vibration isolated equipment: Do not rigidly or directly connect electrical connections, instrumentation and gauge lines to vibration isolated equipment. Connect to vibration isolated equipment as follows:

- Restrict instrumentation and gauge lines to, and located on, the equipment or equipment base. Where connection to remote points is required, use copper tube of maximum 6 mm OD to bridge between the static and vibration isolated elements. Provide adequate straight length of tube and a minimum of 3 spiral pigtails of minimum 10 times nominal OD of tube, to accommodate equipment movement, without damage to the tube.
- Provide flexible electrical cable connections between equipment and static elements or building structure.

Piping

General: Design piping to have sufficient flexibility where connected to vibrating equipment and isolate from the building structure where necessary to prevent the transmission of vibration.

Piping connections: Connect piping directly to equipment without flexible connections. Include the following measures when isolating pipe vibration:

- Install vibration isolators, with the same deflection as those used on the equipment to which the pipe is connected, for two hanger spacings distant and either side of the equipment to which it is connected.

- Firmly anchor a pipe clamp to the building structure at the third hanger distant and either side of the equipment. Make provision for a 5 mm minimum rubber or neoprene insert for the full distance between clamp and pipe or wood block for insulated pipe.
- Provide at least 2 off 90° bends in the pipework and sufficient straight pipe between equipment and pipe clamp to accommodate equipment movement and pipe expansion.
- Beyond the third hanger distance from equipment, support piping of 80NB or larger on neoprene block hangers or supports.
- Provide adequate clearance between hanger and isolator on all vibration isolators for pipe movement and expansion.
- Provide for levelling or adjustment of height on all vibration isolators and hangers.
- Provide space between piping and piping penetrations of the building structure using sleeves and packing to approval, to fill the gap.

Drains: Fully support drains from equipment mounted on vibration isolators from the equipment or base and not from the building structure. Provide a sufficient gap between the drainpipe and discharge point to accommodate vibration movement.

Ductwork

General: Design and construct ductwork and fittings so as to prevent generation of air noise, vibration of fittings, or drumming of ductwork, that in the Engineer's reasonable opinion, is considered to be excessive.

Separation: Provide separation between ductwork and ductwork penetrations of the building structure by use of sleeves and packing to approval, to fill the gap. Conform to the requirements of this clause in respect to fire damper and sub duct penetrations.

Installation: Install flexible connections between fans and ducts or plant housings using Wavebar barium sulphate impregnated flexible material of 4 kg/m² grade. Mechanically fix and seal the Wavebar to the fan/duct/housing to achieve an airtight joint. Provide 80 mm minimum space between fan and duct or housing and make sure fabric is not taut when installed.

Vibration isolation mountings

General: Except for external equipment that is not connected to the structure of any building, support rotating or reciprocating equipment on mountings as follows:

- For static deflections < 15 mm: Single or double deflection neoprene in-shear mountings incorporating steel top and base plates and a tapped hole for bolting to equipment.
- For static deflections ≥ 15 mm: Spring mountings.

Selection: Provide mountings selected to achieve 95% isolation efficiency at all normal operating speeds of the equipment.

Installation: Set and adjust vibration isolation mounting supports to give clearance for free movement of the supports.

Spring mountings: Provide freestanding laterally stable springs as follows:

- Clearances: ≥ 12 mm between springs and other members such as bolts and housing.
- High frequency isolation: 5 mm neoprene acoustic isolation pads between baseplate and support.
- Levelling: Provide bolts and lock nuts.
- Minimum travel to solid: ≥ 150% of the designated minimum static deflection, based on the unloaded spring length.
- Make sure the operating deflection does not exceed 70% of the maximum allowable deflection
- Ratio of mean coil diameter to compressed length at the designated minimum static deflection: ≥ 0.8:1.
- Snubbing: Snub the springs to prevent bounce at start-up.
- Vertical resilient limit stops: To prevent spring extension when unloaded, to serve as blocking during erection and which remain out of contact during normal operation.
- Deflection to be equal on all supports to an item of plant, provide for adjustment of this.

Bridging across pad or cup isolators: Bridging across pad or cup isolators achieved by holding down bolts or hangers is not acceptable. Where holding down bolts or hangers are necessary to secure the equipment, install them so that the vibration and noise isolation efficiency are unimpaired.

Location of vibration isolators: Locate vibration isolators so as to provide overall stability of the equipment and mass under all operating conditions, including starting and stopping. Provide outriggers as necessary to achieve this.

Seismic restraints for vibration isolated equipment: Seismic restraints shall not interfere with the isolation efficiency or general operation of vibration isolation mountings. Where seismic restraints are required, it is recommended these are provided as separate units to the vibration isolation mountings to avoid bridging of the isolators.

Rigidity: Provide equipment base components that are rigid and do not flex or bend under operating conditions, to the detriment of the drives, couplings or equipment.

Corrosion protection: Protect vibration isolators against corrosion.

Vibration isolator manufacturer: Provide vibration isolators equal to Mason Industries. Full details of any alternatives to be submitted to the Contracts Administrator.

Vibration isolators minimum deflection (mm) and type:

Equipment description	**Basement or ground supported slab**	**Floor span Less than 6000**	**Floor span 6000-9000**	**Floor span 9000-12000**	**Floor span 12000-15000**
Absorption Chiller	10 N	20 RS	20 RS	40 RS	40 RS
Centrifugal and Screw Chiller (All Types)	30 RS	30 RS	40 RS	40 RS	65 RS
Reciprocating Compressor					
750 RPM and Over	30 S	30 S	40 S	65 S	90 S
Reciprocating Chiller					
750 RPM and Over	30 RS	30 RS	40 RS	65 RS	90 RS
Engine generator set	30RS	30RS	40RS	65RS	90RS
Boilers	10 N	20 RS	20 RS	40 RS	65 RS
Pumps					
1 to 4 kW	10 N	20 S	20 S	40 S	40 S
4 to 55 kW	20 S	20 S	40 S	40 S	65 S
55 kW and Over	20 S	40 S	65 S	65 S	90 S
Fans - all types > 1 kW motor power with fan speed of					
500 RPM and Over	10 N	20 S	40 S	65 S	90 S
499-300 RPM	10 N	65 S	65 S	90 S	90 S
299-175 RPM	10 N	90 S	115 S	115 S	115 S
Cooling Tower and Evaporative Condenser - Fans with speed of					
500 RPM and Over	10 N	20 RS	40 RS	65 RS	90 RS
499-300 RPM	10 N	65 RS	65 RS	90 RS	115 RS
299-175 RPM	10 N	90 RS	115 RS	115 RS	115 RS
Air Compressors - Industrial	30 S	30 S	40 S	65 S	90 S
Packaged Air Conditioning Units and Fan Coil Units	As for Fans				

LEGEND:
- N - Double deflection neoprene mounts
- S - Free standing steel compression type spring isolator or hanger of unhoused open design and neoprene pad or cup, as specified, with levelling bolts.
- RS - Free standing steel compression type spring isolator of unhoused open design and neoprene pad as specified, with levelling bolts and where required seismic restraints to the degree specified in clause Seismic Restraints.

3.14 NOISE CONTROL

General

Project acoustician: Hann Tucker

Project acoustic requirements: In accordance with the requirements of the project acoustician.

Occupied spaces: Do not exceed noise from equipment defined in subsection **SELECTIONS** clause **SCHEDULES** subclause **Noise Level Schedule.**

Equipment adjustment: Install, balance and adjust installed equipment and associated systems to avoid noise generation at system components.

Treatment: The documentation defines the minimum extent of acoustic treatment.

Distinct tonal characteristics: Eliminate any distinct tonal characteristics caused by the services. Where distinct tonal characteristics exist, these are to be assessed as per ISO 1996-2 Annex C and any tonality adjustments are to be applied.

Annoying noises: Eliminate any rattles, hums, buzzes and other potentially annoying noises caused by the services.

Design: Assess acoustic requirements and provide additional acoustic treatment as required to meet subsection **SELECTIONS** clause **SCHEDULES** subclause **Noise Level Schedule**.

3.15 FINISHES TO BUILDING SERVICES

General

Requirement: If exposed to view (including in plant rooms), paint new building services and equipment.

Control panels and the like: Paint items of equipment such control panels and the like off site in accordance with the requirements specified herein.

Damage to the paintwork: Where damage occurs to the paintwork of such equipment, return the damaged item to the respective paint shop to be refinished with primer and final coats to restore the surface to its specified conditions of colour, finish and quality.

Exceptions: Do not paint chromium or nickel plating, anodised aluminium, GRP, stainless steel, non-metallic flexible materials and normally lubricated machined surfaces. Surfaces with finishes applied off-site need not be re-painted on-site provided the corrosion resistance of the finish is not less than that of the respective finish documented.

Standard: Conform to the recommendations of BS 6150.

Powder coating

Standard:

- Aluminium for architectural applications: To BS EN 12206-1 and BS 6496.
- Galvanised steel: To BS 6497.

Paint application

Coats: Apply the first coat immediately after substrate preparation and before contamination of the substrate can occur. Make sure each coat of paint or clear finish is uniform in colour, gloss, thickness and texture and free of runs, sags, blisters or other discontinuities.

Combinations: Do not combine paints from different manufacturers in a paint system.

Protection: Remove fixtures before starting to paint and refix in position undamaged when painting is complete.

Underground metal piping

Requirement: Provide corrosion protection for the following:

- Underground ferrous piping.
- Underground non-ferrous metal piping in corrosive environments.

Corrosion protection: Select from the following:

- Cathodic protection: Sacrificial anodes or impressed current. Incorporate a facility for periodic testing. Conform to the recommendations of BS EN 12954.
- Continuous wrapping using proprietary petroleum taping material.
- Impermeable flexible plastic coating.
- Sealed polyethylene sleeve.

Aggressive soils: If metallic piping or components are installed in chemically aggressive soil, provide additional protection as follows:

- Material: Continuous polyethylene sleeve to ASTM D1248 with a minimum thickness of 0.25 mm.
- Installation: Wrap or sleeve pipes and components. Tape joints between sections of polyethylene and between polyethylene and piping.

Repairs to finishes
Requirement: Repair damaged finishes to restore their corrosion protection, appearance and service life.

Low VOC emitting paints
Paint types: To the recommendations of BS 6150.

3.16 PAINTING

General
General: Paint items of equipment such control panels and the like off site in accordance with the requirements specified herein.

Damage to the paintwork: Where damage occurs to the paintwork of such equipment, return the damaged item to the respective paint shop to be refinished with primer and final coats to restore the surface to its specified conditions of colour, finish and quality.

Galvanised or other applicable metal surfaces: Etch-prime galvanised or other applicable metal surfaces before painting. Apply at least one coat prior to installation in position. Apply at least one coat after erection.

3.17 MARKING AND LABELLING

General
Requirement: Mark and label services and equipment for identification purposes as follows:

- Locations exposed to weather: Provide durable materials.
- Pipes, conduits and ducts: To BS 1710 throughout its length, including in concealed spaces.
- Cables: Label to indicate the origin and destination of the cable.

Consistency: Label and mark equipment using a consistent scheme across all services elements of the project.

Label samples and schedules
Submission timing: Before marking or labelling.

Requirement: For each item or type of item, prepare a schedule of marking and labelling, include the following:

- A description of the item or type of item for identification.
- The proposed text for marking or labelling.
- The proposed location of the marking and labelling.

Electrical accessories
Circuit identification: Label isolating switches and outlets to identify circuit origin.

Provide labels to each of the following:

- Controller.
- Switchboard.
- Switchgear cubicle.
- Pilot lamp.
- Push button.
- Switch, relay.
- And similar equipment.

Operable devices
Requirement: Mark to identify the following:

- Controls.
- Indicators, gauges, meters.
- Isolating switches.

Equipment concealed in ceilings
Location: Provide a label on the ceiling, to indicate the location of each concealed item requiring access for routine inspection, maintenance and/or operation and as follows:

- Tiled ceilings, locate the label on the ceiling grid closest to the concealed item access point.
- Flush lined ceilings, locate adjacent to closest access panel.

Concealed equipment: Items to be labelled include the following:

- Fan coil units and terminal equipment (e.g. VAV terminals).
- Fire and smoke dampers.
- Isolating valves not directly connected to items otherwise labelled.
- Motorised dampers.

Wall mounted equipment in occupied areas

Location: Provide labels on wall mounted items in occupied areas including the following:

- Services control switches.
- Temperature and humidity sensors.

Points lists

Automatic control points: Provide plasticised, fade-free points lists for each automatic control panel and include terminal numbers, point addresses, short and long descriptors in the lists. Store in a pocket on the door of the panel.

Pressure vessels

General: Mount manufacturer's certificates in glazed frames on a wall next to the vessel.

Valves and pumps

General: Label to associate pumps with their starters and valves. Screw fix labels to body or attach label to valve handwheels with a key ring.

Underground services

Survey: Accurately record the routes of underground cables and pipes before backfilling. Include on the record drawings.

Records: Provide digital photographic records of underground cable and pipe routes before backfilling. Include in operation and maintenance manual.

Location marking: Accurately mark the location of underground cables and pipes with route markers consisting of a marker plate set flush in a concrete base, engraved to show the direction of the line and the name of the service.

Markers: Place markers at ground level at each joint, route junction, change of direction, termination and building entry point and in straight runs at intervals of not more than 100 m.

Marker bases: 200 mm diameter x 200 mm deep, minimum concrete.

Direction marking: Show the direction of the cable and pipe run by means of direction arrows on the marker plate. Indicate distance to the next marker.

Plates: Brass, aluminium or stainless steel with black filled engraved lettering, minimum size 75 x 75 x 1 mm thick.

Plate fixing: Waterproof adhesive and 4 brass or stainless steel countersunk screws.

Marker height: Set the marker plate flush with paved surfaces, and 25 mm above other surfaces.

Marker tape: Where electric bricks or covers are not provided over underground wiring, provide a 150 mm wide yellow or orange marker tape bearing the words WARNING – electric cable buried below, laid in the trench 150 mm below ground level.

Plastic pipe: Provide a detectable marker tape with trace wire to identify the route of buried piping. Terminate with 1000 mm coil in a readily accessible location. Tag to match the record drawings.

Labels and notices

Materials: Select from the following:

- Cast metal.
- For indoor applications only, engraved two-colour laminated plastic.
- Proprietary pre-printed self-adhesive flexible plastic labels with machine printed black lettering.
- Stainless steel or brass minimum 1 mm thick with black filled engraved lettering.

Emergency functions: To BS 1710.

Colours: Generally to BS 1710 as appropriate, otherwise black lettering on white background except as follows:

- Danger, warning labels: White lettering on red background.
- Main switch and caution labels: Red lettering on white background.

Edges: If labels exceed 1.5 mm thickness, radius or bevel the edges.

Labelling text and marking: To correspond to terminology and identifying number of the respective item as shown on the record drawings and documents and in operating and maintenance manuals.

Lettering heights:

- Danger, warning and caution notices: Minimum 10 mm for main heading, minimum 5 mm for remainder.
- Equipment labels within cabinets: Minimum 5 mm.
- Equipment nameplates: Minimum 40 mm.
- Identifying labels on outside of cabinets: Minimum 5 mm.
- Isolating switches: Minimum 5 mm.
- Switchboards, main assembly designation: Minimum 25 mm.
- Switchboards, outgoing functional units: Minimum 10 mm.
- Switchboards, sub assembly designations: Minimum 15 mm.
- Valves: Minimum 20 mm.
- Self-adhesive flexible plastic labels:
  . Labels less than 2000 mm above floor: 5 mm.
  . Labels minimum 2000 mm above floor: 10 mm.
  . Other locations: Minimum 5 mm.

Label locations: Locate labels so that they are easily seen and are either attached to, below or next to the item being marked.

Fixing: Fix labels securely using screws, rivets, proprietary self-adhesive labels or double-sided adhesive tape and as follows:

- If labels are mounted in extruded aluminium sections, use rivets or countersunk screws to fix the extrusions.
- Use aluminium or monel rivets for aluminium labels.

Vapour barriers: Do not penetrate vapour barriers.

3.18 RECORD DRAWINGS

General

Requirement: Prepare record drawings showing the following:

- Installed locations of building elements, services, plant and equipment.
- Off-the-grid dimensions and depth if applicable.
- Any provisions for the future.

Recording, format and submission

Progress recording: Keep one set of drawings, CAD or BIM files on site at all times, expressly for the purpose of marking changes made during the progress of the works.

Drawing layout: Use the same borders and title block as the contract drawings.

Quantity and format: Conform to **SUBMISSIONS.**

Endorsement: Sign and date all record drawings.

Accuracy: If errors in, or omissions from, the record drawings are found, amend the drawings and re-issue in the quantity and format documented for **SUBMISSIONS**.

Date for submission: Not later than 2 weeks after the date for practical completion.

Services record drawings

Additional requirements for services record drawings as follows:

- Extensions and/or changes to existing: If a drawing shows extensions and/or alterations to existing installations, include sufficient depiction of the existing installation to make the drawing comprehensible without reference to drawings of the original installation.
- Domestic cold water or fire mains: Show the pressure available at the initial connection point and the pressure available at the most disadvantaged location on each major section of the works.
- Stormwater: If storm water pipes are shown, include the pipe size and pipe grade together with the maximum acceptable flow and the actual design flow.

Diagrams: Provide diagrammatic drawings of each system including the following:

- Controls.
- Piping including all valves and valve identification tags.
- Principal items of equipment.
- Single line wiring diagrams.
- Acoustic and thermal insulation.
- Access provisions and space allowances.
- Fasteners.
- Fixtures.
- Switchgear and control gear assembly circuit schedules including electrical service characteristics, controls and communications.
- Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

CAD base drawings: DXF or DWG

Subsurface services: Record information on underground or submerged services to the documented quality level, conforming to BSI PAS 128.

Subsurface services recording quality level: QL-A.

Utility services drawings: Information recorded by utilities for their own purposes are to conform to the utilities own requirements.

Provision of information by the engineer

Digital copies of information: The engineer will provide to the contractor one copy of tender drawings and/or the specification/s in electronic format for production of shop drawings subject to the following:

- All drawings will be in AutoCAD format and Adobe PDF format.
- All text documents will be in Adobe Acrobat format.
- Norman Disney & Young will not take responsibility for errors resulting from the accuracy of any information supplied in electronic format.
- The information supplied by Norman Disney & Young is copyright and is used solely for the production of shop drawings for this project. Do not disclose or sell to other parties.
- The information supplied by Norman Disney & Young electronically does not form part of the contract documents.
- Norman Disney & Young accepts no responsibility for the accuracy of the architectural details that are incorporated as part of the drawings.
- Electronic copies of 3D files will not be provided.

3.19 OPERATION AND MAINTENANCE MANUALS

General

Authors and compilers: Personnel experienced in the maintenance and operation of equipment and systems installed, and with editorial ability.

Referenced documents: If referenced documents or technical worksections require that manuals be submitted, include corresponding material in the operation and maintenance manuals.

Subdivision: By installation or system, depending on project size.

Contents

Requirement: Include the following:

- Table of contents: For each volume. Title to match cover.
- Directory: Names, addresses, and telephone and facsimile numbers of principal consultant, subconsultants, contractor, subcontractors and names of responsible parties.
- Record drawings: Complete set of record drawings, full size.
- Drawings and technical data: As necessary for the efficient operation and maintenance of the installation. Include:
  . Switchgear and control gear assembly circuit schedules including electrical service characteristics, controls and communications.

  - . Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- Installation description: General description of the installation.
- Systems descriptions and performance: Technical description of the systems installed and mode of operation, presented in a clear and concise format readily understandable by the principal's staff. Identify function, normal operating characteristics, and limiting conditions.
- Systems performance: Technical description of the mode of operation of the systems installed.
- Documentation: Including the schedule of essential functionality and performance requirements.
- Digital photographic records of underground services to **MARKING AND LABELLING, underground service**.
- Equipment descriptions:
  - . Name, address, email address and telephone and facsimile numbers of the manufacturer and supplier of items of equipment installed, together with catalogue list numbers.
  - . Schedules (system by system) of equipment, stating locations, duties, performance figures and dates of manufacture. Provide a unique code number cross-referenced to the record and diagrammatic drawings and schedules, including spare parts schedule, for each item of equipment installed. Equipment schedules in tabular form including the equipment designation used on the drawings, manufacturer's name and contact details, equipment name plate data, function of item, associated system and capacity data.
  - . Manufacturers' technical literature for equipment installed, assembled specifically for the project, excluding irrelevant matter. Mark each product data sheet to clearly identify specific products and component parts used in the installation, and data applicable to the installation.
  - . Supplements to product data to illustrate relations of component parts. Include typed text as necessary.
- Certificates:
  - . Certificates from authorities.
  - . Copies of manufacturers' warranties.
  - . Product certification.
  - . Test certificates for each service installation and all equipment.
  - . Test reports
  - . Test, balancing and commissioning reports.
  - . Control system testing and commissioning results.
- 7 day record of all trends at commissioning.
- Operation procedures:
  - . Manufacturers' technical literature as appropriate.
  - . Safe starting up, running-in, operating and shutting down procedures for systems installed. Include logical step-by-step sequence of instructions for each procedure.
  - . Control sequences and flow diagrams for systems installed.
  - . Legend for colour-codes services.
  - . Schedules of fixed and variable equipment settings established during commissioning and maintenance.
  - . Procedures for seasonal changeovers.
  - . If the installation includes cooling towers, a water efficiency management plan.
- Maintenance procedures:
  - . Detailed recommendations for periodic maintenance and procedures, including schedule of maintenance work including frequency and manufacturers' recommended tests.
  - . Manufacturer's technical literature as appropriate. Register with manufacturer as necessary. Retain copies delivered with equipment.
  - . Safe trouble-shooting, disassembly, repair and reassembly, cleaning, alignment and adjustment, balancing and checking procedures. Provide logical step-by-step sequence of instructions for each procedure.

  - . Schedule of spares recommended to be held on site, being those items subject to wear or deterioration and which may involve the principal in extended deliveries when replacements are required. Include complete nomenclature and model numbers, and local sources of supply.
  - . Schedule of normal consumable items, local sources of supply, and expected replacement intervals up to a running time of 40 000 hours. Include lubrication schedules for equipment.
  - . Schedules for recording recommissioning data so that changes in the system over time can be identified.
  - . Instructions for use of tools and testing equipment.
  - . Emergency procedures, including telephone numbers for emergency services, and procedures for fault finding.
  - . Safety data sheets (SDS).
  - . Instructions and schedules to HVCA SFG20.
- Maintenance records:
  - . Prototype service records prepared to include project specific details including:
    - * Fire detection, smoke detection and alarm tests
    - * Fire protection systems with supporting records (e.g. sprinkler systems)
    - * Water hygiene risk assessment
    - * Emergency lighting system test records
    - * Electrical fixed wiring inspection
    - * Gas safety inspection records
    - * Closed systems microbiological and chemical analysis
    - * Air conditioning inspection report to TM44 regulations
  - . Prototype periodic maintenance records and report, prepared to include project specific details.
    - * Legionella test results
    - * Pressure systems
    - * Lighting protection
    - * Lift inspection reports
  - . Number of pages: The greater of 100 pages or enough pages for the maintenance period and a further 12 months.
- Emergency information: For each type of emergency, including fire, flood, gas leak, water leak, power failure, water failure, system or sub system failure, chemical release or spill, include the following:
  - . Emergency instructions.
  - . Emergency procedures including:
    - * Instructions for stopping or isolating.
    - * Shutdown procedures and sequences.
    - * Instructions for actions outside the property.
    - * Special operating instructions relevant to the emergency.
    - * Contact details relevant to the emergency.

Emergency information manual

Form of emergency information: Provide one of the following:

- An index and coloured tabs identifying emergency information for each type of emergency within the Operation and maintenance manual.
- A separate Emergency manual containing copies of emergency information from the main Operation and maintenance manual

Format – electronic copies

Scope: Provide the same material as documented for hardcopy in electronic format.

Quantity and format: Conform to **SUBMISSIONS** subclause **Electronic submissions**.

Printing: Except for drawings required in **RECORD DRAWINGS** provide material that can be legibly printed on A4 size paper.

Provided on indexed digital media labelled with the following information:

- Project name.
- Service.
- Document or drawing number/s.
- File type/s.
- Date.

Information format: Provide information in both the original source format and in Unlocked PDF.

Provide a browser based index of the media.

Produce original content in one of the following file formats:

- Microsoft Office
- Adobe InDesign

Provide preformatted documents produced by other software products for inclusion in the manuals in one of the following formats:

- Adobe Portable Document Format (PDF).
- Postscript File, Level III.

Provide information not available from originators as digital files as follows:

- Include all relevant part of the hard copy document.
- Be at a resolution of 300 dpi when printed full size.
- Be in an Unsecured PDF/A format.
- Confirm readability on computer screen.

Drawings: conform to the following:

- A suitable file format that can be viewed and opened by the latest two versions of AutoCAD or Revit.
- Prepared using one of the latest two versions of AutoCAD with all details of the layers system utilised.
- Prepared as a black and white postscript plot file or Adobe Acrobat PDF file in the same standard as for AutoCAD or Revit printed versions.

Format – hard copies

- Acceptance: Not acceptable.

Date for submission

Draft submission: The earlier of the following:

- 6 weeks before the date for practical completion.
- 4 weeks before the commencement of training on services equipment.

Interim documentation: Provide any interim documentation required for the safe and legal operation of the plant.

Date for final submission: Within 2 weeks after practical completion.

3.20 BUILDING LOG BOOK

General

Requirement: Provide a Building Log Book, or modify and update the existing Building Log Book.

Standard: In accordance with the current Building Regulations Part L.

Level of detail: CIBSE TM31: “Building log book toolkit” and associated templates.

Authors and compilers: Personnel experienced in the maintenance and operation of equipment and systems installed, and with editorial ability.

Language: English, concise and in terminology understood by non-technical personnel.

Content

Requirement: Include the following:

- Include details of the installed building services plant and controls, their method of operation and maintenance and other details that collectively enable energy consumption to be monitored and controlled.
- Include information and details that allow the building operator to:

- Understand the design intent
- Augment the commissioning and handover process

Requirement: Information to be:

- More concise and accessible information than in the O&M manuals
- A record for building alterations and performance
- Useful information at the point of selling
- Improved energy efficiency by providing a method of monitoring building performance against good practice benchmarks and design estimates.

Responsibility for content: As defined in subsection **SELECTIONS** clause **SCHEDULES** subclause **Building Log Book Responsibility Schedule.**

Format – electronic copies

Requirement: As per **OPERATION AND MAINTENANCE MANUALS.**

Format – hard copies

Acceptance: Not acceptable.

Date for submission

Requirement: As per **OPERATION AND MAINTENANCE MANUALS.**

3.21 BUILDING USER'S GUIDES

General

Requirement: Provide both technical and non-technical guides in accordance with BREEAM requirements

3.22 TOOLS AND SPARE PARTS

Spare parts

General: Provide spare parts listed in the appropriate worksections.

Replacement: Replace spare parts used during the maintenance period.

Tools and spare parts schedule

Submission timing: At least 8 weeks before the date for practical completion.

Requirement: Prepare a schedule of tools, portable instruments and spare parts necessary for maintenance of the installation. For each item state the recommended quantity and the manufacturer's current price. Include the following in the prices:

- Checking receipt, marking and numbering in conformance with the spare parts schedule.
- Packaging and delivery to site.
- Painting, greasing and packing to prevent deterioration during storage.
- Referencing equipment schedules in the operation and maintenance manuals.
- Suitable means of identifying, storing and securing the tools and instruments. Include instructions for use.

3.23 PORTABLE APPLIANCE TESTING

Equipment

Extent: All equipment that forms part of the works that is brought to site and plugged in to the mains shall be tested and tagged.

Standard: Conform to the IET Code of Practice for In-service Inspection and Testing of Electrical Equipment.

Responsibility: The company that provides the equipment is responsible for testing and tagging of the equipment.

3.24 TESTING

Attendance

General: Provide attendance on tests.

Testing authorities

General: Except for site tests, have tests carried out by an Accredited Testing Authority.

Test instruments: Use instruments calibrated by an Accredited Testing Authority.

Test reports

General: Indicate observations and results of tests and conformance or non-conformance with requirements.

Notice

Inspection: Give sufficient notice for inspection to be made of the commissioning and completion testing of the installation.

Controls

General: Calibrate, set and adjust control instruments, control systems and safety controls.

Circuit protection

General: Confirm that circuit protective devices are sized and adjusted to protect installed circuits.

Completion tests

General: Test the works under the contract to demonstrate conformance with the documented performance requirements of the installation.

Functional checks: Carry out functional and operational checks on energised equipment and circuits and make final adjustments for the correct operation of safety devices and control functions.

Type test reports: Required as evidence of conformance of proprietary equipment.

Sound pressure measurements

General: Perform noise measurements if instructed.

Sound pressure level measurements: Conform to the following:

- External: To BS 4142 using a Type 1 Sound Level Meter, unless specific assessment methods are identified in local regulations.
- Internal: To Approved Document E and BS 8233 using a Type 1 Sound Level Meter. Measurements to be 1.2-1.5 m above floor level and at least 1.2 m away from any surface.
- Correction for background noise: To BS 4142 and BS 8233.
- Measurement positions: If a test position is designated only by reference to a room or space, do not take measurements less than 1 meter from the floor, ground or walls.
- Sound pressure level analysis: Measure the sound pressure level and the background sound pressure level over the full range of octave band centre frequencies from 31.5 Hz to 8 kHz at the designated positions.
- Sound pressure levels: Measure the A-weighted sound pressure levels and the A-weighted background sound pressure levels at the designated positions.

Report: Provide a report as follows:

- conforming to BS 4142.
- Include all calculations made.
- Include a plan of the measurement locations.
- Include any noticeable Rattles, hums, buzzes, tones and other potentially annoying noises.

Noisy items: Rectify noisy items as follows:

- Adjust equipment, guards and housings.
- Replace with equipment that is within the noise requirements.
- Upgrade acoustic treatment.

Criteria: Noisy equipment is where:

- Noise levels are above the space acoustic criteria due to the services.
- Any noticeable rattles, hums, buzzes, tones and other potentially annoying noises are present.

Payment for noise measurements: Bear the costs of the noise measurements if any noisy equipment is identified..

Fire system test - integrated fire modes

Requirement: Before Practical completion conduct tests to verify that the independent fire systems operate together in integrated manner.

Notice: Give notice of the test.

Systems: Test the following:

- Fire alarm system.
- Emergency warning system.
- Fire sprinkler system.
- Access control system.
- Security system.
- Mechanical services systems.
- Building management systems.

Restoration: Demonstrate that the systems return to normal operation after the tests.

Report: Submit a report detailing the tests and results.

Certification

General: On satisfactory completion of the installation and before the date of practical completion, certify that each installation is operating correctly.

3.25 COMMISSIONING

General

Requirement: Prior to practical completion, test and commission all installed equipment and systems to verify that they operate correctly and function in accordance with the manufacturer's requirements, this specification and the contract conditions.

Submissions: Submit before commencement of commissioning, a program itemising the systems and the proposed dates for conducting acceptance tests in accordance with the program.

Indicate on the program the numbers of commissioning staff on site at any time during the testing and commissioning period and the anticipated duration of the various activities on a system by system basis.

Notifications: Notify the Contract Administrator one week prior to the proposed date of tests and the associated witnessing requirements.

Provide for site tests all necessary labour, materials, stores, apparatus and instruments. Fuel and electric power will be provided by the Contractor except where specified otherwise. Where tests are required to be performed away from the site, provide everything necessary to carry out the tests.

Submit details of the proposed commissioning procedures and methods of measurement with sufficient time for review by the Engineer and resubmisison (if required). Commissioning procedures and measurement methods which are not approved or not in accordance with this specification will not be accepted as evidence that the systems have been correctly commissioned.

Start-up, testing & commissioning

Start-up, commission & test the systems: Start up, commission and test the systems in accordance with the approved program. Appoint a representative who is qualified to commission the installation, remaining on site until the system is operating to the satisfaction of the Contract Administrator and signed off accordingly.

Conduct the tests as detailed in the specification and perform all additional tests as instructed to bring the plant, equipment and systems into running order.

Operate all systems and equipment to the extent required for final installation, adjust and calibrate controls and instruments and rectify all faults.

Arrange for the setting up of major equipment provided under these works to be supervised by the manufacturer's representative until the equipment is operating satisfactorily.

Co-ordinate manufacturer's representatives so that testing is carried out according to the approved program.

Perform tests on dates as agreed.

Commissioning records

Inspection & Test Reports: Prepare Inspection and Test Reports which are appropriate to each test. Document and record the results of commissioning tests on the Inspection and Test Reports. Make such modifications and additions which are necessary to meet the requirements of the project.

Submit Test Results: When a system is operating satisfactorily, submit a copy of the test results on standard test forms. Provide neatly hand written or typed test forms and reports and incorporate within the Operation and Maintenance manual.

Keep a record of tests carried out and the results obtained and compile into a test report.

Ensure that acceptance tests are witnessed when the test results are considered to be satisfactory. Two acceptance tests of each system will be witnessed if necessary. If the equipment fails the second test, witnessing of further tests will be charged at the Contract Administrator's (or their nominated representative) current hourly rates plus expenses and such charges will be deducted from payments otherwise due to the Contractor.

Equipment calibration

Calibration: Ensure that all instruments have been calibrated by an Accredited Testing Authority within 6 months of the date of use and a current calibration certificate is available for inspection. Do not use instruments to measure quantities which are outside their accurate measuring range. If there is reasonable doubt as to the accuracy of an instrument, then re-calibrate the instrument or alternatively, measure the quantities with another approved instrument.

3.26 TRAINING

General

Duration: Instruction to be available for the whole of the commissioning and running-in periods.

Format: Conduct training at agreed times, at system or equipment location. Also provide seminar instruction to cover all major components.

Operation and maintenance manuals: Use items and procedures listed in the final draft operation and maintenance manuals as the basis for instruction. Review contents in detail with the principal's staff.

Certification: Provide written certification of attendance and participation in training for each attendee. Provide register of certificates issued.

Control of systems

General: Provide operators with adequate training to operate the systems as installed before being given control of the associated systems to proficiently run these on a day to day basis.

Energy objectives: Make sure the operators understand the control of the features relating to meeting any energy conservation objectives.

Resources

General: Provide training courses for up to 8 staff/operators/managers of the building to attend.

Training days: Provide a minimum of 8 full training days over a period of at least 6 months and no more than 8 months. Provide sufficient training to make sure that building managers or staff have all the information and understanding needed to operate and maintain the commissioned features and systems.

Content

Include in the training:

- Design intent (including energy/environmental features).
- Review of controls setup, programming, alarms and trouble shooting.
- O&M Manuals - including a presentation on the manuals, their format content and use.
- Building operation (start-up, normal operation, unoccupied operation, seasonal changeover and shutdown).
- Interactions with other systems.
- Optimising energy efficiency.
- Workplace health safety and welfare (WHS) issues, systems and practices.
- Maintenance requirements and sourcing replacements.
- Occupant satisfaction feedback.

Demonstrators

General: Provide experienced technical people on location, who have a complete technical knowledge of the installations, to instruct and demonstrate to the Principal or their nominated representatives the method of operation and maintenance required for all components of the installations.

Maintenance

General: Explain and demonstrate to the principal's staff the purpose, function and maintenance of the installations.

Operation
General: Explain and demonstrate to the principal's staff the purpose, function and operation of the installations.

Seasonal operation
General: For equipment requiring seasonal operation, demonstrate during the appropriate season and within 6 months.

3.27 CLEANING

Final cleaning
General: Before the date for practical completion, clean throughout, including all exterior and interior surfaces except those totally and permanently concealed from view.

Labels: Remove all labels not required for maintenance.

3.28 WARRANTIES

General
Requirement: If a warranty is documented, name the principal as warrantee. Register with manufacturers as necessary. Retain copies delivered with components and equipment.

Warranty period: Start warranty periods at acceptance of installation.

Approval of installer: If installation is not by manufacturer, and product warranty is conditional on the manufacturer's approval of the installer, submit the manufacturer's written approval of the installing firm.

Manufacturers standard warranty expiry: Where the manufacturers of items of equipment give standard warranty periods in excess of the defects liability period, assign such warranties to the principal prior to final completion.

3.29 PRACTICAL COMPLETION

General
General: Make the date of practical completion the same date as the practical completion of the head contract. For this purpose practical completion is when commercial operation of the installation or part thereof is ready to be used substantially for the purpose for which it is intended. Provide preliminary operating instructions at this stage to sufficiently ensure safe and reasonable use of the installation.

Minor works: Finalise minor works necessary within a reasonable time (to be agreed at practical completion), to complete painting, labelling, rectification of minor installation and/or commissioning defects and provision of final operation and maintenance manuals. Payment of retention money (or release of bank guarantees), due at the date of practical completion, will not be made until the above minor works are finalised and a certificate has been issued to this effect.

Incomplete minor works: In cases where any of the above minor works are incomplete at the time of practical completion under the head contract, the granting of practical completion under the contract will be provisional upon finalisation of the minor work above within the agreed time, and will not diminish the Contractor's rights under the Contract and Head Contract.

Building occupant's cooperation: Where the above minor works are carried out while the installation is being used or occupied, cooperate with the building's occupants to carry out the minor works with minimum interruption and minimum interference.

Certificate of compliance: Prior to the issue of a Practical Completion Certificate, complete and forward a Certificate of Compliance to the Engineer. List the systems and items of plant forming the works and certify that the work is complete and is in accordance with the specification and accompanying drawings. In signing the Certificate of Compliance, the Contractor acknowledges that the Engineer and the Principal rely upon the Certification provided.

3.30 DEFECTS LIABILITY

General
Set the defects liability period for each stage of the works for 12 calendar months from the date of issue of a Certificate of Practical Completion certifying that stage of the works to be practically completed. Install equipment at any stage but do not put into commercial use at the completion of that stage until a Certificate of Practical completion is received and accepted.

Replace or otherwise make good:

- Any defect that becomes apparent during the defects liability period and;

- Damage that results from a defect or from work to remedy the defect, and that becomes apparent during the defects liability period.

Adjust and test equipment: Adjust and test equipment replaced during the defects liability period to show that this part of the system is giving commercial operation and the replaced items are performing according to the specified operating conditions.

Equipment repaired or replaced: If equipment is repaired or replaced during its defects liability period extend the defects liability period a further 12 months, commencing from the date of completion of making good, renewal or replacement.

Defects rectification work: Carry out all defects rectification work as instructed in writing within 7 days after such notices, or on failure. The right is reserved to engage others to finish the work without further notice and to deduct the costs from amounts otherwise due or payable, or to recover costs if they exceed the amounts due or payable. This action will not vitiate any of the responsibilities implied by this specification.

3.31 FINAL COMPLETION

General

Final completion means the end of the defects liability period or when defects notified during the defects liability period have been made good, whichever occurs last.

4 SELECTIONS

4.1 SCHEDULES

Commercial Areas

General Design Criteria Schedule

Occupancy density: To the following

Area	Occupancy
Office	1 person per 8 m²
Reception	Maximum 10 people

Services availability: Capacity to operate 24 hours per day, 7 days per week.

Mechanical Services External Design Criteria Schedule

Ambient conditions: Plant selection based on the following:

Function	Conditions
Space heating	-4 °C dry bulb / 0% RH
Cooling installation	31 °C dry bulb / 21 °C wet bulb
Heat rejection plant	35 °C dry bulb / 22 °C wet bulb

Note: Outside the normal dry bulb and wet bulb conditions heating and cooling plant may fail to maintain the required heating or cooling capacity. The plant will continue to operate to the extreme operating conditions, but at reduced capacity.

Mechanical Services Internal Design Criteria Schedule

Requirement: To the following:

Area	Temperature
Cat A office area - heating	20 °C ± 2 °C
Open plan office area (Cat A)	22 °C ± 2 °C

Area	Temperature
Entrance area / lobby (conditions to be achieved within occupied zone not in vicinity of external doors) – heating and cooling	Minimum 18 °C Maximum 24 °C
Toilet and shower areas – heating and cooling	Minimum 18 °C Maximum uncontrolled
Ancillary back of house areas – heating and cooling	Minimum 18 °C Maximum uncontrolled
Plant and ancillary areas – frost protection	4 °C minimum
A3 Retail 01 (commercial building)	As per lobby
Retail and Light Industrial Units	By tenant

Mechanical Services Internal Ventilation Rates Design Criteria Schedule

Requirement: To the following:

Area	Function	Rate
Open plan office area	Outside air provision	12 L/s/person (1.5 L/s/m^2 at 1 person per 8 m^2)
	Future tenant connection allowance (e.g. for meeting rooms)	+10%
Entrance area / lobby	Supply ventilation	10 L/s/person
	Extract ventilation	Via leakage through facade & entrance doors
Toilet and shower areas	Extract ventilation	10 air changes per hour
	Supply ventilation	8 air changes per hours and/or to suit extract rate and maintain pressure differential
Plant and ancillary areas	Ventilation rate	To suit plant requirements
A3 Retail 01 (commercial building)	Supply and extract ventilation	Part of the ground floor lobby area.
Light Industrial Unit 01/06	Supply and extract ventilation	General ventilation to the units will be installed by the future tenant using the available area of louvres around the façade as specified by the Architect for tenant connection.
Light Industrial Unit 02/07	Supply and extract ventilation	General ventilation to the units will be installed by the future tenant using the available area of louvres around the façade as specified by the Architect for tenant connection.
	Supplementary extract ventilation	Provision of 8 m^3/s for extract ventilation to roof.

Area	Function	Rate
Light Industrial Unit 03/08	Supply and extract ventilation	General ventilation to the units will be installed by the future tenant using the available area of louvres around the façade as specified by the Architect for tenant connection.
Light Industrial Unit 04/09	Supply and extract ventilation	General ventilation to the units will be installed by the future tenant using the available area of louvres around the façade as specified by the Architect for tenant connection.
	Supplementary extract ventilation	Provision of 5 m^3/s for extract ventilation to roof.
Light Industrial Unit 05/10	Supply and extract ventilation	General ventilation to the units will be installed by the future tenant using the available area of louvres around the façade as specified by the Architect for tenant connection.

Mechanical Services Local Space Cooling Design Criteria Schedule

Requirement: To the following:

Area	Load density
Equipment	25 W/m^2 NIA total available, with 15 W/m^2 NIA allowed for in Cat A fan-coil units and additional 10 W/m^2 NIA available at riser for future tenant connection for supplementary use.
Lighting	8 W/m^2 NIA
A1 retail unit (shell and core)	Space for tenant heating/cooling to 160 W/m^2 NIA
A3 retail unit (shell and core)	Space for tenant heating/cooling to 250 W/m^2 NIA
B1 light industrial unit (shell and core)	Space for tenant heating/cooling to 200 W/m^2 NIA

Electrical Services Design Criteria Schedule

Maximum demand: Building services maximum demand based on the following allowances:

Area	Power density
Lighting (toilet and common areas)	10 W/m^2
Small power (at workspace)	25 W/m^2
Small power (on floor infrastructure, at riser)	23 W/m^2 diversified to 15 W/m^2 for the purpose of maximum demand calculations
A1 retail unit (shell and core)	160 W/m^2 NIA

Area	Power density
A3 retail unit (shell and core)	250 W/m^2 NIA
B1 light industrial unit (shell and core)	200 W/m^2 NIA Each unit can accommodate an increase to 300 W/m^2 NIA but the average over all units cannot exceed 200 W/m^2 NIA nominated above.
Plant areas	To suit actual load

Vertical transportation: Incorporated into the small power allowance for on floor infrastructure

Standby power backup/generation: Landlord life safety systems will be supplied with 8 hours power backup by an on-site roof-mounted life-safety generator with integral belly tank.

Tenant standby power backup/generation: No provision for a standby generator to support landlord or tenant loads (other than life safety systems).

Lighting Services Design Criteria Schedule

Lighting levels: Based on the following average levels in line with CIBSE recommendations:

Area	Lighting levels (lux)
Office	300–500 lux average at floor level generally; 350 lux average at task plane; 0.6 uniformity at task plane generally (uniformity at edges of floor plates and corners may decrease)
Reception	200-300 (300 at desk level)
Lift lobbies	200
Circulation space	150-200
Stairwells	150
Toilets, including end of trip areas	200
Plantrooms – internal	150-200
Plantrooms - external	50 lux on accessible routes

Lighting control system: To Approved Document L2A.

Emergency lighting: To BS 5266. Design to achieve an average maintained illuminance of 1 lux along defined escape routes with a minimum of 0.5 lux at any point on the floor plane for a period of three hours after a break in the mains electricity supply. Levels shall not be influenced by any borrowed daylight.

Fire Protection Services Design Criteria Schedule

Requirement: To the following:

System	Criteria
Sprinkler system	BS EN 12845, OH III, wet installation
Fire detection and alarm system	BS 5839 Part 1, L1 + Manual
Emergency voice communication system	BS 5839 Part 9, combined Type A/B outstations
Dry riser system	BS 9990, operating pressure of 12 bar

Public Health Service Design Criteria Schedule

Requirement: To the following:

System	Criteria
Drainage	BS EN 12056-2 Velocity of flow 0.75 m/s to 1.2 m/s.
Trade waste	Tenants with cooking/food preparation facilities are to provide, as part of their fit out, suitable grease interceptors prior to connection to the landlord's foul drainage system.
Rainwater systems	BS EN 12056-3 Category 2 level of protection to building. Storm return period 1.5 x life span of building.
Natural gas systems	Provision of gas supply to site and then meter cupboard, space for meter per retail or light industry unit, pipework from meter cupboard to end retail or light industry unit. 200 kW per unit. Nominal gas pressure available at the meter assembly is 21 mbar. Maximum pressure loss through system between meter and point of use 1 mbar.
Incoming cold water mains	Existing connection, sized to replenish volume of cold water storage tanks within a 4 hour period with maximum velocity of flow of 1.5 m/s.
Potable water storage	50% of 40 litres/person per day, 8 m^2 net internal area per person.
Non-potable water storage	Minimal volume for washdown and ancillary items. Category 5 storage.
Hot and cold water pipework distribution	BS EN 806 and IOP loading units method. Maximum velocity of flow restricted to 1.5 m/s within plant rooms and risers, 1.0 m/s within ceiling voids
Pressure of water services	Minimum 1.5 bar to draw off point, maximum 5 bar or as per manufacturer requirements.
Above ground sanitation	BS EN 12056- 2 Discharge Unit calculation method with an intermittent use frequency K factor of 0.5. The shower and changing areas facilities (end of trip) will utilise a frequency K factor of 1.0.
Hot water generation	Domestic hot water stored at 60 °C with hot water service flow at least 55 °C. Centralised unvented domestic hot water storage calorifiers served by heat pumps. Local unvented domestic hot water calorifiers (new basement showers) . Local unvented electric hot water heaters (landlord amenities). Domestic hot water stored at 60 °C, hot water service flow 55 °C.
Drinking water supply	Served from potable boosted cold water service.

Vertical Transportation Services Design Criteria Schedule

Requirement: To the following:

System	Criteria
Car loading	80%
Average times (up-peak)	≤ 25 s waiting and time to destination ≤ 110 s, OR ≤ 30 s waiting where time to destination is ≤ 80 s
Handling capacity (up-peak)	12% of design population in 5-minute period (85% up / 10% down / 5% inter-floor)
Waiting time (two-way lunch time)	≤ 40 s
Handling capacity (two-way lunch time)	13% of design population in 5-minute period (45% up / 45% down / 10% inter-floor)
Goods lift	Dedicated goods passenger lift to meet BCO Guidelines. These guidelines recommend consideration of a second lift where NIA exceed 10,000 m^2. At approx. 11,000 m^2 and being low-rise, a second lift is not provided.

Noise Criteria for Building Services Installation

Internal: To the following:

System	Criteria
Office	NR38 (40-50 dBA LeqT for BREEAM)
Toilets	NR45
Reception	NR40

External: Plant and equipment selection such that the noise level meets the planning conditions.

Residential Buildings

General

Requirement: To the current standards and requirements of the National House Building Council (NHBC).

Mechanical Services External Design Criteria Schedule

Ambient conditions: Plant selection based on the following:

Function	Conditions
Space heating	-4 °C dry bulb / 0% RH

Note: Outside the normal dry bulb and wet bulb conditions heating plant may fail to maintain the required heating or cooling capacity. The plant will continue to operate to the extreme operating conditions, but at reduced capacity.

Mechanical Services Internal Design Criteria Schedule

Requirement: To the following:

Area	Temperature
Units	22 °C ± 2 °C
Entrance area / lobby– heating and cooling	Uncontrolled

Area	Temperature
Plant and ancillary areas – frost protection	4 °C minimum

Mechanical Services Internal Ventilation Rates Design Criteria Schedule

Ventilation of residential units and internal common areas will generally be provided via using Mechanical Ventilation with Heat Recovery (MVHR) also known as Whole House Ventilation to each apartment. The MVHRs incorporate summer bypass mode. Purging is achieved by openable window.

The refuse room is ventilated by external louvres, fan assisted.

Electrical Services Design Criteria Schedule

Maximum demand: Building services maximum demand based on the following allowances:

Area	Power density
Lighting	10 W/m²
Small power (in unit)	25 W/m²
Small power (on floor infrastructure, at riser)	23 W/m² diversified to 15 W/m² for the purpose of maximum demand calculations
Plant areas	To suit actual load

Lighting Services Design Criteria Schedule

Lighting levels: Based on the following average levels in line with CIBSE recommendations:

Area	Lighting levels (lux)
Units	200-300
Lift lobbies	200
Circulation space	150-200
Stairwells	150
Plantrooms – internal	150-200
Plantrooms - external	50 lux on accessible routes

Lighting control system: Switched in units. Motion sensor in lobby, plant, stairwells and corridors.

Emergency lighting: To BS 5266. Design to achieve an average maintained illuminance of 1 lux along defined escape routes with a minimum of 0.5 lux at any point on the floor plane for a period of three hours after a break in the mains electricity supply. Levels shall not be influenced by any borrowed daylight.

Fire Protection Services Design Criteria Schedule

Requirement: To the following:

System	Criteria
Sprinkler system	None
Fire detection and alarm system	BS 5839 Part 1, Category L5 in common areas (including back of house and plant) and BS 5839 Part 6, Category LD2 in apartments

System	Criteria
Emergency voice communication system	None
Dry riser system	BS 9990, operating pressure of 12 bar

Public Health Service Design Criteria Schedule

Requirement: To the following:

System	Criteria
Drainage	BS EN 12056-2 Velocity of flow 0.75 m/s to 1.2 m/s.
Rainwater systems	BS EN 12056-3 Category 2 level of protection to building. Storm return period 1.5 x life span of building.
Incoming cold water mains	Existing connection, sized to replenish volume of cold water storage tanks within a 4 hour period with maximum velocity of flow of 1.5 m/s.
Potable water storage	The sum of : 50% of daily demand based on: Studio – 105 litres per bed space (2 bed spaces) 1 bedroom – 105 litres per bed space (2 bed spaces) 2 bedroom – 65 litres per bed space (4 bed spaces) 3 bedroom – 50 litres per bed space (6 bed spaces) 4 bedroom – 50 litres per bed space (8 bed spaces) and water storage for fire sprinklers to BS 9251
Non-potable water storage	Minimal volume for washdown and ancillary items. Category 5 storage.
Hot and cold water pipework distribution	BS EN 806 however pipe sizing is to be in accordance with the loading units method of CIPHE (IOP). Maximum velocity of flow restricted to 1.5 m/s within plant rooms and risers, 1.0 m/s within ceiling voids
Pressure of water services	Minimum 1.5 bar to draw off point, maximum 5 bar or as per manufacturer requirements.
Above ground sanitation	BS EN 12056- 2 Discharge Unit calculation method with an intermittent use frequency K factor of 0.5.
Hot water generation	Instantaneous generation from local Heat Interface Unit (HIU) within each apartment. Sizes as follows: Studio/ 1 bed (1 bathroom) – 30 kW 2 bed/ 3 bed (2 bathrooms) – 45 kW 4 bed (2 bathrooms) – 45 kW
Drinking water supply	Served from potable boosted cold water service.

Noise Level Schedule

Steady sources: Conform to:

- CIBSE Guide A table 1.5 and table 1.22 NR values. For unlisted spaces or where no criteria is provided, before selecting any associated equipment, select the nearest available listed space, and confirm the criteria with the Engineer.

Short duration sources: Conform to:

- CIBSE Guide A table 1.5 and table 1.22 NR values. Where a range is provided, use the higher value. Add 5 to the value. Use this value as the maximum A-weighted Lmax, fast noise level for the space.

Installation Benchmarking Schedule

Benchmarking of services installation is required for the following areas:

- First-fix of a residential unit
- Sample section of electrical, mechanical and public health risers

Building Log Book Responsibility Schedule

Responsibilities: To the following:

Section Title	A	E	C	SC
Building History	S		L	
Purpose and Responsibilities	S		L	
Links to other key documents			L	S
Main Contacts			L	S
Commissioning, Handover and Compliance			L	S
Overall Building Design	L		S	
Part L As Constructed Carbon Emission Rate Calculation			L	S
Summary of Areas and Occupancy	S		L	
Summary of Main Building Services Plant	S		L	S
Overview of Controls/BMS			L	S
Occupant Information			L	S
Metering, Monitoring and Targeting Strategy			L	S
Building Energy Performance Records			L	S
Maintenance Review			L	S
Compliance Certificates			L	S
Test Certificates			L	S

A - Architect
E - M&E Engineer
C - Main Contractor
SC - M&E Sub-Contractor/s
L - Lead Party, responsible for providing information
S - Secondary Party, required to provide input

VOL 2: Systems & Quality

VOL 2: Systems & Quality: Systems & Quality

0001 SUMMARY OF WORKS

1 GENERAL

1.1 DOCUMENTATION PACKAGE

Public health services drawings

The Norman Disney & Young public health services specification consists of the following:

- The General requirements specification.
- The Public health services systems & quality specification.
- The Public health services schedules.

2 PUBLIC HEALTH SYSTEMS SUMMARY

General

Summary: The public health services are summarised in the following sections.

Water services

General: Provide water services summarised as follows:

Mains water connections:

- connections to the Thames Water water supply infrastructure,
- double check valve, pressure reducing valve, and isolating valves as documented,
- major water leak detection systems on the incoming water supplies to meet BREEAM WAT 03 credit requirements as documented,
- particle filtration as documented,
- isolation system to enable local shutdown of plant and equipment,
- storage tank serving potable water distribution system including ancillary equipment and supports,
- backflow prevention systems including CAT 5 tank and booster unit including ancillary equipment and supports,
- thermal insulation on mains water system.

Domestic cold water distribution systems:

- pressurisation system for water distributions as documented,
- water conditioning and disinfection units
- domestic cold water distribution system,
- thermal insulation on cold water system,
- demand-based flow control devices on water supplies to meet the requirements of BREEAM and Approved Document G,
- leak detection systems,
- valved and metered branches for tenant fit out or future extension as documented,
- water meters as documented,
- proprietary water meters and shut-off valve system for leak prevention and escape of water prevention as provided by WINT Water Intelligence or approved equivalent,
- isolation systems to enable local shutdown of rooms, fixtures, plant and equipment,
- backflow prevention devices/systems to mitigate the risk of cross-connection as documented,
- pressure reducing systems where required to reduce the water pressure to an acceptable level.
- water category 5 (CAT 5) system:
- CAT 5 distribution system,
- thermal insulation on CAT 5 distribution system,
- hose taps as documented,
- local frost protection system,
- blanked connections to irrigation system as documented,

Domestic hot water systems:

- water heating systems including ancillary equipment and supports,
- heated water distribution systems,
- stagnant leg temperature maintenance systems,
- thermal insulation of heated water distribution,
- demand-based flow control devices on water supplies to meet the requirements of BREEAM and Approved Document G,
- thermostatic mixing valves,
- isolation systems to enable local shutdown of rooms, fixtures, plant and equipment,
- backflow prevention devices/systems to mitigate the risk of cross-connection as documented,
- pressure reducing systems where required to reduce the water pressure to an acceptable level,
- balancing valves on hot water circulation system,
- proprietary water meters and shut-off valve system for leak prevention and escape of water prevention as provided by WINT Water Intelligence or approved equivalent,
- local frost protection system,

Camden Council Planning requirements:

- Submit a notice specifying the maximum potential wholesome water within 5 days of the completion of each new apartment. This should be calculated using the water efficiency for new dwellings and must not exceed 125 litres per person per day

Sanitary plumbing and drainage

General: Provide the sanitary plumbing and drainage services summarised as follows:

- connection to the Thames Water infrastructure as documented in the Civil Engineer's (AKT II) documentation,
- sanitary plumbing system and associated venting,
- sanitary drainage system,
- sealed sanitary waste and vent branches for tenancy fit out as documented,
- sealed sanitary drainage system for tenancy fit out as documented,
- access provisions to sanitary plumbing and drainage systems.
- discharge points for all equipment.
- gullies and tundishes.

Stormwater and roof drainage

General: Provide stormwater and roof drainage services summarised as follows:

- connection to below ground rainwater drainage outfall as documented in the Civil Engineer's (AKT II) documentation,
- rainwater (roof) drainage systems,
- siphonic roof drainage systems (proprietary system as a contactor design portion),
- stormwater attenuation systems including integrated rain water harvesting tank.
- blue roof systems (proprietary system as a contractor design portion),
- connections to landscape drainage systems including piping and, tree pit outlets.

Fuel gas services

General: Provide fuel gas services summarised as follows:

- connection to Cadent Gas' gas main,
- gas pipes distribution system including valves as documented,
- pressure reducing systems,
- isolation systems to enable local shutdown of pipe risers,
- emergency gas shut off solenoid valve on the main gas supply to the building linked to the fire system to enable shutdown,
- localised button-operated emergency gas shut off valve to rooms containing gas fired equipment,
- gas detection systems,
- gas certification and installation approvals.

Surface water treatment systems

General: Provide surface water treatment systems summarised as follows:

- rainwater harvesting system,
  fuel and oil capture system.

Fixtures and fittings

General: Provide fixtures and fittings summarised as follows:

- bib taps serving tree pit irrigation as documented,
- all necessary connectors, brackets and fastenings required to complete the installation,
- apply sealant/caulking at the mounting surface junctions.

0138 WORKS BY OTHERS

1 GENERAL

1.1 CROSS REFERENCES

General

It is anticipated that the contractor will sub contract some elements of the work though this is not a requirement of this specification. This section of the specification describes works and/or provisions associated with the services list of items which form part of this contract though may be performed by other trades or parties. The contractor shall ensure that all sub contractors liaise with other trades to ensure that all requirements are provided as required for the completeness and proper operation of the equipment or system.

Requirement: Conform to the following worksection(s):

- *0171 General requirements*.

1.2 INTERPRETATION

Definitions

General: For the purposes of this worksection the definitions given in the *0171 General requirements* worksection apply.

External machinery space: A separate room external to a lift well, in which lift control and drive equipment is installed.

Integral machinery space: The lift car roof and space within a lift well in which lift control and drive equipment is installed.

Machinery space: A separate room or lift car roof and space within a lift well in which lift control and drive equipment is installed.

Abbreviations

General: For the purposes of this work section the following abbreviations apply:

- BMS: Building Management System.
- EMS: Energy Management System.
- DHW: Domestic Hot Water.
- FDCIE: Fire Detection Control and Indicating Equipment Panel.
- LTHW: Low-Temperature Heating Water.

1.3 COORDINATION WITH OTHER SERVICES

General

General: Coordinate the works with other services including existing services within the vicinity of the works.

Claims: Claims for variations, extensions of time, delay, interruption or other items will not be accepted.

Note: Equipment that is installed without due regard to other trades will be relocated at no additional cost.

2 PUBLIC HEALTH INTERFACE WORKS

2.1 GENERAL

General

Purpose: The public health works require connections to and from other trades. This section contains the demarcation points between the trades.

Complete operation: Liaise with other trades to ensure that all requirements are provided for complete operation of the equipment or system.

2.2 BUILDING WORKS

Penetrations

Builders works as follows:

- Provide penetrations for services and make good following services installation.

Public health works as follows:

- Provide information confirming where penetrations are required.
- Provide any specific details required for the penetrations.

Cutting and patching

Builder's works as follows:

- Undertake cutting, patching, trimming and making good of the building structure, walls and ceilings for the installation of outlets, in-wall boxes and the like.

Plantrooms and plinths

Builder's works as follows:

- Provide concrete plinths with metal surround; 100 mm high under floor mounted equipment.
- Provide plantroom floor topping graded without undulation to floor wastes.
- Provide waterproofing to the plantroom floor and floor wastes.

Kerbs

Builder's works as follows:

- Provide kerbs around floor penetrations and at entry doors to plantrooms in accordance with details submitted.

Access panels

Builder's works as follows:

- Provide openings and access panels in ceilings, bulkheads, walls and at other positions as required of minimum size for adjustment of, access to, and maintenance of, equipment and pipework in accordance with details submitted.

Ventilation

Builder's works as follows:

- Provide ventilation provisions where not provided by the mechanical contractor.

Building in

Builder's works as follows:

- Building in of pipe sleeves.
- Building in of holding bolts.
- Building in of conduits.
- Building in of other fittings.

Public health works as follows:

- Provide items to be built-in.
- Pre-positioned items to be built-in.

Under flashing

Builder's works as follows:

- Provide under flashing or flashing collars on pipes and flues penetrating the roof or external walls.

Light and power for construction

Builder's works as follows:

- Provide general lighting and temporary power for construction purposes.

Utilities for commissioning

Builder's works as follows:

- Provide utilities to commission and test run the systems as follows:
  - . Water.
  - . Sewer.
  - . Fuel gas
  - . Electricity.

Protection
Builders works as follows:
- Prevent damage to services by vehicles using protection bollards or guards.

Hoisting, all equipment
Builder's works as follows:
- Hoisting of equipment.

Scaffolding
Builder's works as follows:
- Allow use of the Builder's scaffolding.

Rebates
Builder's works as follows:
- Provide rebates in structure for housing equipment and pipework.

Integration into building works
Builder's works as follows:
- Integrate concrete pits, trenches, grates, frames, covers and the like into the structure.
- Integrate cast-in services and equipment supports into the building structure.

Structure
Builder's works as follows:
- Provide structure to support plant and equipment.
- Provide structure to support pipework and gutters when full.

Noggins
Builder's works as follows:
- Provide noggins in walls for the fixing of fixtures and tapware.

Roofing system
Builder's works as follows:
- Provide roofing systems, sumps and sump outlets (pops).
- Install roof drainage outlets for concrete roofs.

Public health works as follows:
- Provide stormwater and roof drainage piping systems.
- Supply roof drainage outlets for concrete roofs.
- Make connections.

Roof flashings
Builders works as follows:
- Provide roof penetrations and primary flashings for pipes and equipment penetrating the roof.

Public health works as follows:
- Provide secondary flashing.

Rooms
Builder's works as follows:
- Construct rooms, risers and cupboards to house services.
- Provide signage to equipment enclosures, risers and rooms.

Public health works as follows:
- Confirm room requirements.

Excavation and backfilling
Builders works as follows:
- Provide excavation and backfilling associated with structure.

Fire rating
Builder's works as follows:
- Provide fire-rated shafts or compartments for services passing between fire compartments.

Structural supports storage tank
Builder's works as follows:
- Provide structural supports for storage tanks.

- Prepare ground base for storage tanks.

2.3 MECHANICAL SERVICES

Domestic Cold Water

Domestic cold water is required in the following locations:

- Mechanical services plantrooms.

Mechanical works as follows:

- Confirm flow rates, pressure and water quality requirements for each location.
- Provide any backflow prevention devices required to prevent cross contamination.
- Extend piping from termination points to mechanical services equipment.

Public health works as follows:

- Provide domestic cold water branches to the confirmed locations terminated with an isolation valve.
- Provide domestic cold water from a Category 5 (CAT 5) water distribution system to each location.
- Consider the hazard category of backflow prevention.

Hose cock in mechanical plantroom

Public health works as follows:

- Provide a hose cock in the mechanical services plantrooms.

Floor wastes in plantrooms

Locations of floor wastes:

- Mechanical services plantrooms.

Public health works as follows:

- Provide trapped floor wastes.

Tundishes for equipment and ductwork

Locations of tundishes:

- Fan coil units

Mechanical works as follows:

- Confirm flow rate and maximum discharge temperature for each item of equipment.
- Provide drain piping from fan coil units to discharge over tundishes.

Public health works as follows:

- Provide tundishes within 2 metres of each item of equipment.

BMS connection to public health equipment

Items controlled and monitored as follows:

Items monitored as follows:

- cold water pressurisation pumps
- water Category 5 pressurisation pumps
- rain water harvesting pressurisation pumps,
- tank water and temperature levels
- electromagnetic water conditioners,
- ultra violet disinfection units,
- water filters,
- hot water circulation pumps,
- heated water system,
- frost protection on all pipework exposed to external conditions,
- major water leak detection system on the incoming water supplies,
- leak detection system in toilet areas as documented.

Mechanical works as follows:

- Cable: Provide cable from the BMS system to the public health equipment.
- Connection: Do not make final connection.
- Temperature sensors: Provide sensors and all cabling.

Public health works as follows:

- Connection point: Provide a connection point for BMS cables within the equipment control panel or an external marshalling box.
- Termination: Make final connection of the BMS cables.
- Sensor pockets: provide pockets for temperature sensors.
- Signal protocol: Confirm the type of signals provided and required.

BMS connection to water meters

Mechanical works as follows:

- Cable: Provide cable from the BMS system to the metering terminals.
- Connection: Connect signal cabling to the terminals for meters not part of the mechanical works.

Public health works as follows:

- Terminal location: Provide meter with BMS connection terminals.

2.4 FIRE PROTECTION SERVICES

Water supply

Fire systems water supply criteria:

- Grade: Complete as defined by BS EN 12845 , BS 9251
- Locations:
  - Fire Plantroom in commercial block
  - Water risers at each level in the residential blocks

Water supplies are required as follows:

- sprinkler tanks in Commercial Block
- sprinkler system serving apartments in residential blocks.

Public health works as follows:

- Provide water supply tapings to water main in the commercial block.
- Provide water supply to meet confirmed requirements incorporating back flow prevention terminating as documented.
- Provide water meter assemblies.
- Provide monitoring device to water supply isolation valves to confirm valve spindle positions.
- Provide boosted cold water supply to residential sprinkler system

Fire protection works as follows:

- Confirm flow and pressure requirements.
- Extend fire services water supplies from major leak detection (BREEAM WAT 3) water meter to the sprinkler tank.
- Connect valve monitoring devices to FDCIE.
- Extend fire sprinkler system from boosted cold water risers at each floor in the residential blocks.

Drainage

Drainage is required as follows:

- Static water storage tank drain-down facility and overflow.
- Test drains for sprinkler control valves.
- Floor tundish inside sprinkler in Fire Plantroom
- Floor wastes in Fire Plantroom
- Drainage connection to the fire sprinkler system on each floor in residential block.

Public health works as follows:

- Provide drainage point to match confirmed flow rate.

Fire protection works as follows:

- Confirm flow rate for drainage.
- Piping from fire services equipment to discharge over drainage point provided.

Fire services interface and commissioning

General: Conform to authority requirements.

Sample size: Test all combinations.

Attendance: Attend all tests.

Public health works as follows:

- Complete and test public health controls before testing interface.
- Provide the cause and effect matrix for the hydraulic systems in fire mode.
- Test end to end functionality with other services.
- Provide a written report of the test findings.

Fire protection works as follows:

- Complete and test fire protection controls before testing interface.
- Provide equipment to initiate fire signals.
- Test end to end functionality with other services.

2.5 ELECTRICAL SERVICES

Voltage drop and switchgear discrimination

Public health works as follows:

- Provide discrimination details of switchgear, harmonic current details up to the 35th harmonic and maximum and normal running demands of all hydraulic services switchboards and equipment served directly from the electrical services works.

Electrical works as follows:

- Provide voltage drop, fault level and earth fault loop impedance for all power supplies feeding equipment provided outside the electrical services works.
- Coordination discrimination of all switchgear at the respective switchboards throughout the installation.

Public health works as follows:

- Make sure switchboard accommodate power cables selected by the electrical services contractor.

Electrical works as follows:

- Provide three phase, neutral and earth non essential submains, to the public health services switchboard.
- Terminate and connect submains.

Electrical supply to public health services equipment

Public health works as follows:

- Provide isolating switches adjacent the equipment or within the equipment control panel.
- Provide all interconnecting wiring.

Electrical works as follows:

- Provide electrical supply to the isolators.
- Terminate and connect cabling.

Electronic sensor taps

Hydraulic works as follows:

- Provide sensor taps.
- Connect sensor tap plug to socket outlet.

Electrical works as follows:

- Provide socket outlet adjacent each tap.

2.6 LANDSCAPE CONTRACTOR

General

Landscape works as follows:

- Provide entire irrigation systems and all associated pipework valves and controls.
- Provide landscape water treatment mechanisms and drainage substrates/membrane/fabric to landscape areas.
- Provide channels and grates at theshholds for all landscape areas.

Water supply

Public health works as follows:

- Provide water supplies to meet confirmed requirements with backflow prevention to an isolation valve.
- Provide surface water connection to the drainage channels.

Landscape works as follows:

- Confirm water flow rates, pressure required and water quality.
- Extend water supplies and connect to irrigation equipment.
- Confirm the surface water flow rates,
- Connect the surface water pipe to the drainage channels.

2.7 CIVIL WORKS

General

Demarcation points as follows:

Public health contractor works as follows:

- surface water pipework extended from the building boundary to the attenuation tank,
- surface water pipework extended from the rain water channels situated along the North elevation (in Georgiana Street) to the rain water attenuation tank,
- sanitary drainage connections extended from all fixtures and fittings to the building boundary in Pratt Street,
- foul water and surface water pump lines extended from the below ground pump stations (from above basement slab level)
- vent pipes serving below ground pump stations (from above basement slab level)

Civil contractor works as follows:

- surface water pipework extended from the rain water channels situated along East elevation (in St Pancras Way) and South Elevation (Pratt street) to the building boundary.

Public health works as follows:

- Provide a drawing showing the demarcation locations.

Sewer

Public health works as follows:

- Provide sewer from the project to the demarcation point.
- Make connection at the demarcation point

Civil works as follows:

- Provide sewer from the demarcation point.

Surface Water

Public health works as follows:

- Provide storm water from the project to the demarcation point.
- Make connection at the demarcation point

Civil works as follows:

- Provide surface water from the demarcation point.

0801A PUBLIC HEALTH SYSTEMS

1 GENERAL

1.1 RESPONSIBILITIES

General
General: Design and provide systems as documented.

1.2 DESIGN

Public health systems design
General: Design and provide systems as documented.

Mains water services:

Mains water services in Commercial block

Complete application with Thames Water and arrange for metered mains water connections, extended from Thames Water infrastructure to:

- Commercial block water plantroom;
- Commercial block fire plantroom.

- Mains water supplies to commercial Fire Plantroom is provided with:
  - Thames Water water meter, located in the public footpath;
  - Major leak detection water meter to meet BREEAM WAT 03 credit requirements;
  - pressure reducing devices as documented to reduce the water pressure to an acceptable level;
  - backflow prevention devices to mitigate the risk of cross-connection;
  - isolation systems to enable local shutdown of rooms, fixtures, plant and equipment;
  - drain cock valves on all low points for maintenance.
- Mains water supplies to commercial water plantroom is provided with:
  - Thames Water water meter, located in the public footpath,
  - major leak detection water meter to meet BREEAM WAT 03 credit requirements,
  - particle filtration,
  - water category 5 break tank and booster set,
  - cold water storage tank,
  - pressure reducing devices as documented to reduce the water pressure to an acceptable level,
  - backflow prevention devices to mitigate the risk of cross-connection,
  - isolation systems to enable local shutdown of rooms, fixtures, plant and equipment,
  - drain cock valves on all low points for maintenance.

Mains water services in Marketable residential block, and Affordable residential block.

- Complete application with Thames Water and arrange for metered mains water connection, extended from Thames Water infrastructure to
  - Marketable block
  - Affordable block
- Particle filtration
- Thames Water water meter to serve Category 5 system (landlord water consumption).
- Complete application with Thames Water. Install water meter as documented.
- Water category 5 break tank and booster set
- Cold water storage tank
- pressure reducing devices as documented to reduce the water pressure to an acceptable level,
- backflow prevention devices to mitigate the risk of cross-connection,
- isolation systems to enable local shutdown of rooms, fixtures, plant and equipment,

- drain cock valves on all low points for maintenance.

Mains water services retail units and light industry units.

- Metered mains water is extended from Thames Water infrastructure to each of the industry units:
  - Retail Unit 01 (Marketable block),
  - Light Industry Unit 1,
  - Light Industry Unit 2,
  - Light Industry Unit 3,
  - Light Industry Unit 4,
  - Light Industry Unit 5,
  - Retail Unit 01 (Café)

  Complete application with Thames Water and arrange for connections and installation of 7 No individual connections.
- Each individual connection terminates with timer control draw-off valve to prevent stagnation in the main.

Boosted cold water services (BCWS):

BCWS in Commercial block

System is extended from cold water storage tank, and provided with:

- Electromagnetic water conditioner,
- Ultraviolet disinfection,
- Domestic cold water booster set
- 3 no boosted cold water supplies off the manifold, completed with isolating valves, double check valve, and drain cock valve, serving:
  - Landlord amenities (1 no),
  - Domestic hot water system located on the roof level,
  - tenants water supply, serving tenants risers (4 no).
    - Tenants risers are provided with:
  - timer-controlled draw-off valves to mitigate stagnation in risers,
  - air elimination and surge relief valves and to mitigate pressure surges in risers,
  - spool pieces for future tenant connections on each floor,
  - offline tenant riser connection completed with water meter, isolation valves, backflow prevention valve, and pressure reducing valve.
- Landlord's risers serving landlords amenities on each floor level are provided with:
  - air removal valves to mitigate pressure surges in risers,
  - branches extended to all fixtures and fittings complete with:
    - water meter set,
    - isolation systems to enable local shutdown of rooms, fixtures, plant and equipment,
    - drain cock valves on all low points for maintenance,
    - local leak detection system in the toiles area. Leak detection tape is linked with solenoid valve and complete with electronic alarm, modular sensing cable, water detection probes, and auxiliary equipment. System include BMS interface and alarm relay contacts. System is to be connected to BMS.
    - pressure reducing devices as documented to reduce the water pressure to an acceptable level,
    - backflow prevention devices to mitigate the risk of cross-connection,
    - flow control devices that regulate the supply to water to each landlord toilet areas according to demand (Passive Infrared Detection (PIR) linked to solenoid shut of valves, and leak detection tape linked to solenoid shut off valves will be installed therefore minimise water leaks and wastage from sanitary fittings) to meet BREEAM Wat 02 requirements.

- solenoid valve linked with Passive Infrared System (PIR) to meet BREEAM WAT 03 credit
- trace heating system on all pipework exposed to external condition.

BCWS in Marketable residential block, and Affordable residential block.

System is extended from cold water storage tank, and provided with:

- Electromagnetic water conditioner;
- Ultraviolet disinfection;
- Combined domestic cold water and sprinkler booster set
- Combined boosted cold water system and sprinkler riser
- air elimination and surge relief valves and to mitigate pressure surges in risers,
- BCWS manifold on each residential floor complete with isolation valve and drain cock valve for maintenance.
- Individual, metered tenant boosted cold water supply system extended from the manifolds to all fixtures and fittings in each flat and provided with:
  - pressure reducing system where required to reduce the water pressure to an acceptable level,
  - backflow prevention devices to mitigate the risk of cross-connection,
  - isolating valve and drain cock valve for maintenance
  - Thames Water water meter set.

    Complete application with Thames Water. Install water meter provided by Thames Water as documented on the drawings.
  - Stop cock valve in accessible location to enable shutdown water supply in each individual flat.
  - Check valves on cold water supplies serving dishwasher and washing machines.
- Connection to fire sprinkler system on each residential floor level complete with double check valve and drain cock valve as documented.

Heated water services:

Heated water services in the Commercial block

Centralised domestic hot water system is provided with:

- packaged domestic hot water calorifiers heated by air source heat pump all to be supplied by Mitsubishi Heavy Industries, located on the 7th floor roof over the commercial block, including
  - air source heat pumps,
  - domestic hot water calorifiers installed in insulated and UV protecting shelter,
  - ancillary equipment, buffer vessels and valves as documented
  - trace heating system on all pipework exposed to external condition;
- thermal insulation on heated water distribution system,
- hot water circulation system:
  - electromagnetic water conditioner,
  - domestic hot water circulation pump,
  - thermostatic double regulating valves (balancing valves)
  - isolation systems to enable local shut down of rooms, fixtures, plant and equipment.
- risers provided with air elimination valves.
- branches extended to all fixtures and fittings that require complete with:
  - thermostatic mixing valves area provided on hot water supplies to all ablutionary outlets unless thermostatic mixing valves are incorporated into tapware.
  - isolation systems to enable local shut down of rooms, fixtures, plant and equipment.
  - pressure reducing systems where required to reduce the water pressure to an acceptable level;

- backflow prevention devices/systems to mitigate the risk of cross-connection.
- local leak detection system in the toiles area. Leak detection tape is linked with solenoid valve and complete with electronic alarm, modular sensing cable, water detection probes, and auxiliary equipment. System include BMS interface and alarm relay contacts. System is connected to BMS.

Heated water services in Marketable residential block, and Affordable residential block.

Domestic hot water is generated locally in each apartment. Each local hot water system includes:

- heat interface unit (HIU) documented in mechanical documentation;
- hot water system pipework extended from HIU to sanitary fixtures and fittings;
- thermostatic mixing valves to serve all basins, bath and shower outlets;
- thermal insulation on heated water distribution system;
- isolation systems to enable local shut down of rooms, fixtures, plant and equipment;

A category 5 water services system (CAT5):

CAT5 services in Commercial block.

System is extended from mains water, and provided with:

- CAT 5 packaged break tank and pump set,
- CAT 5 water supply to all bib taps as documented,
- backflow prevention devices,
- isolation systems to enable local shut down of rooms, fixtures and plant,
- pressure reducing devices to reduce the water pressure to an acceptable level,
- trace heating system to all pipework exposed to external condition,
- valved connection to irrigation system as documented,
- rain water harvesting system, extended to the ground floor level bib taps as documented,
- ground floor level bib taps.

CAT5 services in Marketable residential block, and Affordable residential block

System is extended from mains water, and provided with:

- CAT 5 packaged break tank and pump set,
- CAT 5 water supply to all bib taps as documented,
- backflow prevention devices,
- isolation systems to enable local shut down of rooms, fixtures and plant,
- pressure reducing devices to reduce the water pressure to an acceptable level,
- trace heating system to all pipework exposed to external condition.

Rain water harvesting system:

System is extended from the rain water harvesting tank to the tree pit irrigation system (bib taps) and provided with:

- pumped, filtered connection from rain water harvesting tank
- metered category 5 water connection
- UV filter,
- packaged rain water harvesting tank and booster set
- bib taps
- non-potable water distribution system,
- thermal insulation,
- bib taps as documented,
- isolation system to enable local shutdown of fixtures, plant and equipment.

Sanitary plumbing and drainage:

Sanitary plumbing and drainage services in Commercial block.

Secondary ventilated sanitary drainage system is provided to drain all fixtures and equipment includes:

- SVP stacks connected by gravity to the Thames Water sewer in Pratt Street.

  Final connection to the Thames Water sewer is documented under the civil engineer's (AKTII) works package;

Basement level fixtures, and internal ground floor level floor gullies (bin store) are connected to in-ground foul water system, documented by the civil engineer (AKT II). Pumped foul water is conveyed to the gravity sewer. Vent pipes serving in ground pump stations are extended above the roof level.

- venting is provided to permit free-flowing wastewater and maintenance of trap water seals;
- access provisions are made to enable maintenance with minimal impact on building operation;
- sealed sanitary waste and vent branches for tenancy fit out or future extension;
- discharge points for all equipment;
- trapped connections to drainage channels as documented;
- floor waste gullies and tundishes;
- access provisions to enable maintenance of trap water seals,

Sanitary plumbing and drainage services in Marketable residential block, and Affordable residential block.

Primary ventilated sanitary drainage system is provided to drain all fixtures and equipment and includes:

- SVP stacks, and basement level fixtures connected by gravity to in-ground foul water system (foul water pump station, documented by the civil engineer AKT II).

  Pumped foul water is conveyed to the gravity sewer in Pratt Street;

  Vent pipes serving in ground pump stations are extended above the roof level.
- access provisions to enable maintenance of trap water seals,
- discharge points for all equipment.
- floor waste gullies and tundishes.

Sanitary plumbing and drainage services in Retail Units and Light Industry Units.

Provision for ventilated sanitary drainage system is provided to each unit and includes:

- capped sanitary drainage provisions for future tenant's fitout.

  Ground floor level drainage provisions are extended to the gravity sewer in Pratt Street.

  Basement level drainage provisions are connected to the in-ground foul water system, documented by the civil engineer (AKT II);
- capped venting provision for future tenant fitout, extended to atmosphere at roof level;
- tundish and waterless traps serve discharge from draw off valve;

Fuel gas:

There are no gas services installed in Commercial block, Marketable residential block, and Affordable residential block.

Natural gas services in Light Industry Units.

Complete the application with Squire Energy and arrange for the connections:

- gas mains supply extended from the natural gas infrastructure located in St Pratt Street to the gas meter room to allow for the gas load of:
  - 200 kW to each Light Industry Units (5 no)
  - 200 kW gas load for Retail Unit 01 (cafe).
  - 200 kW to allow possible future splitting of the industrial units (5 no)
- emergency gas shut off solenoid valve on the main gas supply to the building linked to the fire system to enable shutdown.
- gas manifold with 11 no gas offtakes completed with capped emergency control valves (ECVs) as a provision for future tenant gas supply.
- gas detection system to be provided in the gas meter room.
- natural ventilation to suit the Network Utility Operator's requirements.
- isolation systems to enable local shutdown of pipe riser and equipment.
- offline, individual connections complete with additional emergency control valve (AECV), isolation valve and purge point extended from gas meter room to 5 no Light Industry Units at the ground floor level, 5 no Light Industry Units at 1st floor level (to allow for future tenancy split) and Retail Unit 01 (Cafe).
- emergency gas shut off solenoid valve on the main gas supply to the building linked to the fire system to enable shutdown.
- gas certification and installation approvals.

Rain water:

- Rainwater from the roof and terraces is conveyed by gravity (conventional) to the rainwater attenuation tanks located in the basement.
- Roof areas are provided with the blue roof system as documented. Rain water from blue roof areas is discharged via blue roof outlets to the attenuation tank. The blue roof drainage system is a proprietary system to be procured by the contractor as a Contractor Design Portion. Undertake all design, calculations and documentation.
- Rain water from the terraces in the office block is provided with the siphonic rain water system discharging rain water to attenuation tank. The siphonic roof drainage system is a proprietary system to be procured by the contractor as a Contractor Design Portion. Undertake all design, calculations and documentation.
- Rainwater attenuation tanks. Rain water from the attenuation tanks is discharged by gravity to the below ground rain water system documented in the Civil Engineer's package. The discharge flow rate is limited to 5.9 L/s by flow restrictor provided at the bottom of the attenuation tank.
- Rain water connections to the door channel thresholds as documented.
- Rain water outlets serving tree pit as documented.
- Oil bypass separator provided between the attenuation tank and the rain water outlets connected to the channels and grates draining the internal services road.
- Pumped rain water system from in ground pump stations is conveyed to rain water attenuation tank.
- Vent pipes serving the in ground pump stations are extended above the roof level.

Public health constraints

Design for durability and maintainability

Design for durability: Develop the design so the systems achieve the documented performance, reliability, service life, energy efficiency and safety requirements, and are easily maintainable.

Access for maintenance: Develop the design so the systems conform to **ACCESS FOR MAINTENANCE** in the *0171 General requirements* worksection.

1.3 PRECEDENCE

General

Worksections and referenced documents:

- The requirements of other worksections of the specification override conflicting requirements of this worksection.
- The requirements of the worksections override conflicting requirements of their referenced documents.
- The requirements of the referenced documents are minimum requirements.

1.4 CROSS REFERENCES

General

Requirement: Conform to the following worksection(s):

- *0001 Summary of works.*
- *0138 Works by others.*
- *0171 General requirements*.

1.5 INTERPRETATION

Definitions

General: For the purposes of this worksection the definitions given in the *0171 General requirements* worksection apply.

Abbreviations

General: For the purposes of this work section the following abbreviations apply:

- SI: International System of Units.
- HSE: Health and Safety Executive.
- BS: British Standard.
- EN: European (Standard).
- ACOP: Approved Code of Practice.
- HSG: Health and Safety Guidance.
- WRAS: Water Regulations Advisory Scheme.
- CCTV: Closed-circuit television.

1.6 STANDARDS

General

Regulations

General: To Building Regulations, Water Supply (Water Fittings) Regulations and Approved Documents.

Approved documents

Sanitation, hot water safety and water efficiency: Regulation 36 and Part G of Schedule 1 to the Building Regulations 2010.

Drainage and Waste Disposal: Part H of Schedule 1 to the Building Regulations 2010.

Standards

Gravity drainage – general: To BS EN 12056-1 Gravity drainage inside buildings: General and Performance Requirements.

Gravity drainage – sanitary: To BS EN 12056-2 Gravity drainage inside buildings: Sanitary pipework, layout and calculation.

Gravity drainage – roof drainage: To BS EN 12056-3 Gravity drainage inside buildings: Roof drainage, layout and calculations.

Gravity drainage inside buildings: Wastewater Lifting Plants: To BS EN 12056-4

Water services: To BS EN 806 Specifications for installations inside buildings conveying water for human consumptions.

Water services: To BS 8558 Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their cartilages. Complementary guidance to BS EN 806.

Water services: To BS 6700:2006+A1:2009 Specification for design installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages

Backflow prevention: BS EN 13077 Devices to prevent pollution by backflow of potable water. Air gap with non-circular overflow (unrestricted). Family A. Type B.

Backflow prevention: EN 1717:2000 – Protection against pollution of potable water in drinking water installations and general requirements of devices to prevent pollution by backflow.

Legionella

ACOP: In accordance with HSE ACOP L8 Legionnaires' disease. The control of legionella bacteria in water systems.

HSG: In accordance with HSG274 Legionnaires' disease.

Materials

Metallic coatings: To BS EN 4525 Metallic coatings.

Plastic tanks: To BS EN 12573 Welded static non-pressurised thermoplastic tanks.

Hot dip galvanised pipe: To BS EN ISO 1461 Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods.

Gas

IGEM UP/2 Installation pipework in industrial and commercial premises.

IGEM UP/10 Installation of flued gas appliances in industrial and commercial premises.

1.7 CONTRACT DOCUMENTS

General

Requirement: Conform to the *0171 General requirements* worksection.

1.8 INSPECTION

Notice

Inspection: Give notice so that inspection may be made of the following:

- Excavated surfaces.
- Concealed or underground services.

1.9 SUBMISSIONS

General

Requirement: Conform to the *0171 General requirements* worksection.

Certification

Certification: Submit certification that the plant and equipment submitted meets the requirements and capacities of the contract documents except for departures that are identified in the submission.

Electrical loading

Electrical loading: Submit information to the relevant electrical trade for all equipment before completion of the main switchboard shop drawings.

Loading and connection: Submit the information for items not supplied from the services switchboards.

Starting characteristics: Submit details for motors with reduced current starting. Ensure starting characteristics are within the characteristics of the respective submain protection devices.

Switchboards: Submit the following information for each building services switchboard:

- Board location and designation.
- For each submain connected to the board, submit the following for each item connected to it:
- Submain designation.
- Item designation and name.
- Power rating in kW.
- Number of phases.
- Full load current per phase.
- Power factor.
- Total current on each phase for respective sub main.

Maintenance program

General: Submit details of maintenance procedures and program, relating to installed plant and equipment, 6 weeks before the date for practical completion. Indicate dates of service visits. State contact telephone numbers of service operators and describe arrangements for emergency calls.

Operation and maintenance manuals

Requirement: Conform to the *0171 General requirements* worksection.

Shop drawings

Standard: To BS EN ISO 128, as applicable.

Requirement: Submit detail drawings at minimum 1:100 scale, showing the following:

- Pipework and equipment layout and sections showing the work to be installed on the level that the services are installed. Do not submit glass floor drawings.

- Riser layouts and sections.
- Piping and other schematic drawings including numbering of each valve to correspond to valve tags notation. Include main premises isolation valves, gas shut-off valves and buttons, gas safety valves, water meters and their locations.
- Inclusions: Include the following on the drawings:
- Access openings, cover plates, valve boxes and access pits.
- Details of control panels including control and power diagrams.
- Insulation of piping, fittings and tanks.
- Location, capacity, type and other relevant details of water heaters, including supports and safe trays.
- All services identification labels.
- Location, type, grade and finish of piping, fittings, valves, meters and pipe supports.
- Provision of trafficable cover plates in the public domain.
- Relevant survey levels.
- Site and floor set out points.
- Tank stands and supporting structures.

Products

Equipment: Documented pump heads are based on provisional equipment selections and estimated pressure drops.

Before ordering equipment, calculate the respective system pressure losses based on the equipment offered and layouts shown on the shop drawings and submit the proposed selections.

Submissions: Submit technical data for all items of plant and equipment.

Data: Include at least the following information in technical submissions:

- Assumptions.
- Calculations.
- Model name, designation and number.
- Capacity of all system elements.
- Country of origin and manufacture.
- Materials used in the construction.
- Size, including required clearances for installation.
- Certification of conformance to the applicable code or standard.
- Technical data schedules corresponding to the equipment schedules in the contract documents. If there is a discrepancy between the two, substantiate the change.
- Manufacturers' technical literature.
- Pump curves for all pumps.
- Type-test reports.
- WRAS approvals.

2 EXECUTION

2.1 GENERAL

Material interfaces

General: Where differing pipe work materials interconnect, a proprietary jointing system approved by both pipe manufacturers is to be used to appropriately interface the materials.

Isolation valve: Where differing water services pipe work materials interconnect, an isolation valve is to be provided at the interface to separate the two systems.

Discharges or connections from dissimilar metals: Do not install discharges or connections from dissimilar metals as they present a risk of adversely affecting downstream/connected components.

Expansion and contraction

General: Make sure that the components of all systems are installed to accommodate the effects of expansion and contraction without any detriment to the system and without any visible distortion or undue stress that may fatigue the system.

Uniformity

General: Maintain the uniformity of type, class and manufacture of pipe, pipe fittings, valves, joints and connections throughout the whole of each piping installation. Where a uniformity substitution is proposed, submit the details and supporting reasons for the uniformity substitution to the Engineer.

Substitute approved materials: Do not substitute approved materials without the written approval of the Engineer.

Monitoring of systems

General: Monitor each service's system as documented.

List monitoring interfaces: Provide a comprehensive list of all monitoring interfaces and points to be connected to the monitoring system provided by others. Include a list of monitoring interfaces in Operation and Maintenance Manuals.

2.2 INSTALLATION

Accessories

General: Provide the accessories and fittings necessary for the proper functioning of the systems, including taps, valves, outlets, pressure and temperature control devices, strainers, gauges and pumps.

Isolating valves: In addition to valves required to meet statutory requirements, provide valves so that isolation of parts of the system for safe isolation of the system in the event of leaks or maintenance causes a minimum of inconvenience to building occupants.

Connections to network utility operator mains

General: Excavate to locate and expose the connection points and connect to the Network Utility Operator mains. On completion, backfill and compact the excavation and reinstate surfaces and elements which have been disturbed such as roads, pavements, kerbs, footpaths and nature verges.

Movement compensation

Compensation: Arrange piping and wiring crossing building expansion joints so that moment in the joint does not cause damage.

2.3 PENETRATIONS

Structural penetrations

General: All penetrations through structural elements must be approved by the structural engineer in writing prior to any work being carried out. Coordinate with building trades as necessary to enable the positioning and fixing in of penetrations and sleeves in line with the construction program.

Fire rated penetrations

General: Fire rate fire services elements that penetrate any fire rated building elements. All fire rating solutions are to be strictly in accordance with the requirements of the controlling authority.

Quality assurance: Provide a quality assurance file detailing all fire rating solutions prior to work commencing for the approval of the controlling authority and other relevant parties. Where required, arrange for the inspection of fire rating installations by the controlling Authority and other relevant parties.

Digital images: Document using digital images, all fire rating of penetrations and include in the quality assurance file.

Schedule: Provide a schedule at the completion of the project that individually numbers, records digital images and specifies the location and type of each fire rated element. Include fire rating schedule in the Operation and Maintenance Manual.

Labelling: All services penetrating fire rated walls shall be suitable tagged and labelled in accordance with BS 1710.

Waterproofing of penetrations

General: Make watertight all penetrations through building elements that are exposed to weather or water. Provide water proofing details/solutions in accordance with the requirements of the manufacturer of the element or water proofing system being penetrated including the relevant trades installing those elements.

Puddle flanges: Provide to all service sleeves and drainage pipework passing through the structure below ground floor level.

Waterproofing details: Submit all proposed waterproofing details to the Engineer and Architect for approval prior to any works taking place.

2.4 ACOUSTIC REQUIREMENTS

General

General: Conform to the requirements of the Acoustic Report for acoustic requirements. In the absence of such a report the installation must conform to the following:

Pipe work

General: Acoustically lag all sanitary plumbing waste pipe work and fittings within internal occupied spaces with a barium impregnated foil faced loaded vinyl, with 25 mm convoluted foam product, and submit for approval prior to installation.

Storm water pipe work: Acoustically lag all storm water pipe work and fittings within internal occupied spaces with a barium impregnated loaded foil faced vinyl, with 25 mm convoluted foam product, and submit for approval prior to installation.

Support pipe work: Support all pipe work with clamps, saddles and munzing rings with neoprene inserts.

Acoustic lagging: Apply acoustic lagging in accordance with the manufacturer's instructions.

Cable ties: Provide acoustic lagging that has commercial grade cable ties around the circumference of the pipe every 500 mm. Make sure compression of the acoustic lagging is not caused by over tightening the cable ties.

Pumps and equipment

General: Provide all pumps and items of equipment with mechanically rotating elements isolated from the structure to minimise noise and vibration from entering the primary structure. Engage a specialist acoustic engineer to review and provide advice on installations at the request of the Engineer.

2.5 PAINTING

General

Paint exposed steel pipework and equipment: Paint all exposed pipework and equipment in plant rooms, open services areas, loading docks and car parking areas on completion, to present a neat finished appearance.

Paint metal fuel gas pipework: Paint all metal fuel gas pipework, including steel and copper, on completion, to present a neat finished appearance.

Professional painters: Make sure all painting is done by experienced professional painters with first class quality paints brought to the site in the manufacturer's sealed containers. Make sure all coats of paint on any one item is of the same type and manufacture and applied as recommended by the manufacturer of the services system being installed. Where painting adversely affects material properties, provide sheathing as necessary to enable painting.

Priming coats: Apply priming coats prior to secondary coats. Provide secondary coats of grey or other filler type and sand smooth as necessary. Use full gloss enamel for the finishing coat and make smooth and as free of brush marks as possible.

Black iron surfaces: Thoroughly clean black iron surfaces of all rust and scale, and remove all welding flux and grease. Give the metal one priming coat, one secondary coat and a finishing coat.

Galvanised surfaces: Thoroughly clean galvanised surfaces of all grease and artificially treat and etch prime where necessary before painting.

Corrosion resistant pipes: Do not paint corrosion resistant pipes in risers, ceilings, or other positions that are not visible. Do not paint flexible connections.

Metal surrounds to concrete plinths: Paint metal surrounds to concrete plinths.

Commencement of painting: Do not commence painting of equipment until the complete plant has been put into operation and accepted by the Contractor.

Control panels: Supply control panels on site, factory painted as specified and suitably protected during installation. Retouch any chips or faults in paint work to the satisfaction of the Contractor.

Fuel gas services: Paint 309 Canary Yellow from BS381C.

2.6 IDENTIFICATION AND LABELLING

General

General: On completion of the works and testing of all systems (or as required otherwise with the construction program), treat the installation to enable the service to be identified or integrated with architectural requirements. Make sure treatment does not interfere with the material properties of the relevant system.

Identification markers: After painting has been completed, identify all main piping and equipment with self-sticking identification markers.

Submission: Submit a list of the markers for identification of equipment and piping, for approval by the Principal and Engineer before ordering. As an alternative to stick-on marking, use approved sign writing. Where material surfaces are not suitable for self-sticking identification markers (i.e. delaminating), retrofit suitable sheathing or surface preparation.

Identify pipework: Identify all pipework (including where concealed) at minimum 3 metre intervals or as required by the Controlling Authority. Where pipes run together, group the labels together. Provide labels at all access openings (e.g. access panels).

Nameplates

General: Provide equipment nameplates that indicate as applicable; pressure, temperature, electrical readings, set points for thermostats, all graphic indications, other controls and pertinent data in English language. Provide lettering of the numerical readings in metric SI units.

Mount nameplate: Mount on motor equipment and controller a rectangular brass or plastic nameplate identifying primary control function and individual position indicating pump number. Provide nameplates with black background and embossed white letters 12 mm high.

Mounting brackets: Mount all nameplates with approved brackets.

Submission: Submit details of nameplate material and fixing to the Engineer.

Nameplates

General: Provide equipment nameplates that indicate as applicable; pressure, electrical readings, other controls and pertinent data in English language. Provide lettering of the numerical readings in metric SI units.

Mount nameplate: Mount on motor equipment and controller a rectangular brass or plastic nameplate identifying primary control function and individual position indicating pump number. Provide nameplates with black background and embossed white letters 12 mm high.

Mounting brackets: Mount all nameplates with approved brackets.

Submission: Submit details of nameplate material and fixing to the Engineer.

Schedule of finishes

General: The following Finishes Schedule is for guidance only.

Equipment services	**Colour**
Exposed service	Chrome plated or stainless steel including wall plates

Identification

General: Provide brass or approved plastic labels on all pilot lights, indicators and controls to indicate manner and function of controls. Include labelling on isolating switches and starters. Make letter height 4 mm minimum and submit layout of all labels to the Contractor for approval before manufacture. Fix all labels with screws.

Nameplate: Provide and mount to each control or isolating valve, a 50 mm rectangular nameplate, with embossed white letters 18 mm high, indicating service and number of valve.

Non drinking water pipes

Below ground: Identify all below ground non drinking water pipes with identification tape fastened along the top of the pipe for its entire length. Identify where barrier pipes have been installed.

Above ground: Identify all above ground non drinking water pipes and outlets and signs to BS 5499 and ISO EN 7010.

2.7 HOT WORKS

General

General: Do not carry out hot works without a relevant hot works permit or approval from the site manager.

Safety: Make sure all hot works are carried out in a safe manner in accordance with the site safety plan.

Fire precautions

General: Implement precautions to protect equipment, structure and materials against fire and damage due to hot works. When undertaking hot works in vertical riser shafts or similar locations,

provide protective covers or fire resistant cloth/mats immediately below the hot works to prevent sparks falling through to lower levels.

Supervise and inspect: At each location where hot works are to be carried out, supervise and inspect surrounding areas to guard against the possibility of fire starting, and have on hand at least two portable carbon dioxide fire extinguishers.

Soldering, welding and brazing

General: Provide silver soldered joints of the capillary type, soldered with silver alloy hard solders having not less than 5% silver content for copper to copper and copper to brass joints, and having not less than 35% silver for copper to steel joints. Dismantle valves where necessary to avoid damage to seats.

Flux: Use suitable fluxes for all brazing and silver soldering, and properly prepare all fittings and tubes.

Welding: Make sure all welding is done by certified, experienced and competent professionals. For systems not defined as pressure piping, do all welding under the supervision of a welding operator certified as above.

Electric welding: Make sure all electric welding is free of defects such as cracks, lack of fusion, incomplete penetration, undercut, slag inclusion and porosity. Prepare all joints properly by bevelling and the like and preheat prior to welding, all as necessary to avoid stress concentration at the welded joint.

Welding electrodes: Make sure welding electrodes are the type leaving a metal deposit, having yield and ultimate strength not less than and similar to the parent metal.

Forged steel backing/spacer rings: Provide forged steel backing/spacer rings for butt welds in steel pipes where cleanliness and prevention of slag intrusion is necessary.

Oxy welded joints: Make sure all oxy welded joints are free of defects such as cracks, lack of fusion, incomplete penetration and porosity. Use oxy welded joints on steel pipes of 50 m diameter and smaller in preference to electric welding.

Brazed joints: Use tobin bronze filler rods for fillet type joints; copper to brass, bronze and gunmetal, and make sure they are all free of defects such as cracks, lack of fusion, and porosity.

2.8 SUPPORT OF PLANT AND EQUIPMENT

Support of roof mounted plant and equipment

Platforms: If a horizontal platform is required, or the area of the plant and equipment is extensive, obtain the advice of a professional engineer for the documentation of a suitable platform.

Balustrades: If balustrades or screening are required, obtain the advice of a registered architect.

Roof level support: If any of the following apply to roof level support, obtain the advice of a professional engineer:

- The total load from any unit of plant or equipment exceeds 500 kg.
- The load from a unit of plant or equipment to any single support point exceeds 100 kg.
- The average loading of plant and equipment over the area extending 1 m on all sides beyond the plant and equipment exceeds 25 kg/m².

0811 SANITARY FIXTURES

1 GENERAL

1.1 RESPONSIBILITIES

General
Requirement: Provide sanitary fixtures as documented.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following worksection(s):
- *0171 General requirements*.
- *0801A Public health systems*.

1.3 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:
- WRAS: Water Regulations Advisory Scheme

1.4 STANDARDS

General
Design for access and mobility: To BS 8300.

Sanitary installations: To BS 6465 Sanitary installations.

Waste fittings: To BS EN 274 Waste fittings for sanitary appliances.

Ceramics: To BS EN 16578 Ceramics sanitary appliances. Sustainability assessment.

1.5 SUBMISSIONS

Certification
General: Submit evidence that proposed tapware is listed in the WRAS Product and Materials Directory of approved products and materials.

Samples
General: Submit samples as documented in the **Sanitary fixtures samples schedule**.

Samples

Samples: Submit samples of each sanitary fixture and appliance for approval prior to the placing of orders.

2 PRODUCTS

2.1 PRODUCTS

Sealants
General: Use only sealants that do not support microbial growth.

Colour: To match fixture.

Wash hand basins
Standard: To BS EN 14688 Sanitary appliances. Wash basins. Functional requirements and test methods.

Communal washing troughs: To BS EN 14296 Sanitary appliances. Communal washing troughs.

Baths
Standard: To BS EN 14516 Baths for domestic purposes.

Standard: To BS EN 15719 Sanitary appliances. Baths made from impact modified coextruded ABS/acrylic sheets. Requirements and test methods.

3 EXECUTION

3.1 GENERAL

Storage and handling

Accessories: Use manufacturer's brackets and accessories if these are available and suitable for the mounting substrate.

Protection: Deliver fixtures to site protected from damage under site conditions by coatings, coverings and packaging. Remove only sufficient protection to permit installation.

3.2 INSTALLATION

General

Position: Provide all sanitary fixtures, in the positions as documented.

Setting-out: Check the setting out of plumbing penetrations in floors, duct walls and cavities with the installation details of the sanitary fixtures specified, the plumbing system used and the duct or cavity space provided, prior to commencing any fabrication or construction.

Accessories: Use manufacturer's brackets and accessories if these are available and suitable for the mounting substrate.

Protection: Deliver fixtures to site protected from damage under site conditions by coatings, coverings and packaging. Remove only sufficient protection to permit installation. Do not strip any protective coating until all painting, cleaning and associated works are completed. Hand over fixtures in an unmarked condition.

Connections: Connect to each fixture supply and waste services. Install plumb and level.

Cutting and fitting: If it is necessary to cut and/or fit substrate to install an item, carry out this before the surface is finished or painted. Remove items when required for painting and protect until re-installed. Cap or plug the open ends of pipes. Reinstall when painting and finishing is complete.

Substrate and fixings: Before installation, make sure that the substrate to which the fixtures are to be installed is adequate for the intended loads and fixings methods. In solid walls, confirm adequacy of the material at fixing locations.

Noggings: In framed construction, provide a solid nogging at each fixing point.

Fixings: Where possible, conceal all fixings from sight and use galvanised or stainless steel. Chrome plate any fixings that are exposed to view. Where fixtures are required to be supported on timber or metal framing, make sure the Contractor provides and fixes backing plates to the supporting structure.

Fixing materials: Provide stainless steel, brass or galvanized fixings in damp areas.

Vitreous china fixtures

General: Undertake preparation, assembly, connections to water supply and sanitary plumbing, application of slurries and sealants in sequence. Install the fixture without stressing its attachment points.

3.3 FIXTURES

Baths

Frame supports: Make sure that all legs or feet are equally loaded.

Position: Set bath firmly with required points fully supported, level and flush.

Ventilation: Provide ventilation to enclosed spaces under each bath.

Size: Aggregate free area of ventilating openings minimum 5000 mm^2.

Wall hung basins

General: Set basins firmly to walls or vanities as detailed. Connect through trap to the drainage system.

Shower cabinets

General: Install to manufacturer's recommendations and details. Make sure that doors fit closely and accurately. Test for water egress around sides and base.

Shower bases

General: Sit base firmly in place to manufacturer's recommendations and details and connect to drainage service, ready for following work.

Vanities
General: Install to manufacturer's recommendations and details. Seal top and upstand to wall surface. Seal cut surfaces to prevent moisture penetration.

Fixture traps
Manufacture: Proprietary manufacture and approved for use in conjunction with the relevant sanitary fixture/product.

Size: To accommodate the expected flow rate and at least equal in size to the fixture outlet connection.

Material: To suit temperature and chemical composition of wastewater.

Exposed basin traps: Provide chrome plated bottle traps. Submit the proposed trap to the Architect for approval prior to installation.

Priming: Where incoming waste or condensate flows are insufficient to ensure a water seal is maintained in any trap, provide a waterless trap or trap priming system.

Shower wastes
Grate size: Not less than 100 mm diameter.

Grate finish: To the Architect's specification. Where not specified, satin finish stainless steel.

Trap location: Accessible for maintenance.

Floor waste gully: The shower waste and gully may serve as a floor waste gully, subject to provision of the required floor gradient.

Tundishes
Size: To accommodate the expected flow rate and prevent splashing.

Location: Concealed within walls with viewing window.

Manufacture: Proprietary manufacture.

Material: Stainless steel.

Priming: Where incoming waste or condensate flows are insufficient to ensure a water seal is maintained in any trap, provide a waterless trap or trap priming system.

Floor wastes / drains
Grate size: Not less than 100 mm diameter.

Trap size: Not less than 100 mm diameter.

Grate finish: To the Architect's specification. Where not specified, satin finish stainless steel.

Locations: Where nominated and wherever required by the Controlling Authority.

Trap location: Accessible for maintenance.

Priming: Where incoming waste or condensate flows are insufficient to ensure a water seal is maintained in any trap, provide a waterless trap or trap priming system.

Stainless steel fixtures
Finish: Satin finish stainless steel.

Surfaces: Of a high standard of workmanship. All visible surfaces free from ripples, distortion, scratches, stains, and other defects. Fully weld, fill, grind and smooth all joins. Treat to match with adjacent surfaces.

Fit: Ensure all units fit accurately into the required positions. Verify all dimensions before commencement of manufacture.

Sink bowls: Carefully form sink bowls of sizes and types as shown, with all corners and angles neatly rounded and undersides treated with approved anti-drum coatings.

Disabled persons' facilities
Requirement: Install disabled persons' fixtures including pans, basins, sinks and showers in accordance with the requirements of the Controlling Authority.

3.4 COMPLETION

Damage
General: Inspect all work and replace or repair to factory condition damaged or marked fixtures and components.

Protective coatings
General: Immediately before the date for practical completion, remove all protective coatings and stickers and clean surfaces. Check and clean debris from traps.

Testing

Requirements: Test as follows:

- Test sanitary fixtures of all kinds by subjecting them to simulated normal use.
- Test fixtures operated by flushing, by operating the flushing mechanism.
- Make sure after each relevant test, the residual water seal in the trap and in the trap of any other fixture connected to the same system of discharge pipes, retains a minimum water seal to Building Regulations Part G. Vent any fixture failing to retain at least a 50 mm water seal (75 mm for basins, bidets, urinals, sinks or trapped standpipes).
- Make sure traps installed within pressurised compartments including (i.e. air plenums) retain at least 70 mm of water seal.

4 SELECTIONS

4.1 SANITARY FIXTURES

General

Requirement: Conform to the sanitary fixtures schedule produced by the Architect.

0812 TAPWARE

1 GENERAL

1.1 RESPONSIBILITIES

General
Requirement: Provide tapware as documented.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following worksection(s):

- *0171 General requirements*.
- *0801A Public health systems*.

1.3 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:

- WRAS: Water Regulations Advisory Scheme

1.4 STANDARDS

General
Design for access and mobility: To BS 8300.

Sanitary installations: To BS 6465 Sanitary installations.

Taps: To BS EN 200 Sanitary tapware. Single taps and combination taps for water supply systems of type 1 and type 2. General technical specification.

Thermostatic mixing valves: To BS EN 1111 Sanitary tapware. Thermostatic mixing valves (PN10). General technical specification

Shower outlets: To BS EN 1112: Sanitary tapware. Shower outlets for sanitary tapware for water supply systems type 1 and type 2. General technical specification

Shower hoses: To BS EN 1113 Sanitary tapware. Shower hoses for sanitary tapware for water supply systems of type 1 and type 2. General technical specification.

Thermostatic mixing valves: To BS EN 1287 Sanitary tapware. Low pressure thermostatic mixing valves .General technical specification.

Authorised products
Standard: Listed in the WRAS Product and Materials Directory of approved products and materials, unless otherwise required by the Network Utility Operator or approved by the Engineer and Controlling Authority.

Labelling
Water efficiency labelling: Provide only products conforming to and labelled to the Water Efficient Product Labelling Scheme.

1.5 SUBMISSIONS

Certification
General: Submit evidence that proposed tapware is listed in the WRAS Product and Materials Directory of approved products and materials.

Samples
General: Submit samples as documented in the **Tapware samples schedule**.

2 PRODUCTS

2.1 PRODUCTS

Authorised products

Standard: Listed in the WRAS Product and Materials Directory of approved products and materials, unless otherwise required by the Network Utility Operator or approved by the Engineer and Controlling Authority.

Labelling

Water efficiency labelling: Provide only products conforming to and labelled to the Water Efficient Product Labelling Scheme.

Accessories

General: Provide escutcheons and cover plates over visible penetrations. Finish and material to match adjacent fixtures.

Sealants

General: Use only sealants that do not support microbial growth.

Colour: To match fixture.

Tap and valve heads

Metal heads and handles: Provide brass fittings or a suitable bush to prevent electrolysis and growth.

Plastic heads and handles: Provide compact fittings designed to prevent fracture and exposure of jagged or rough edges.

Vandal-proof heads: Provide vandal-proof or anti-tampering devices for the designated types.

Water efficiency

Shower heads: Suitable for the pressures and pressure differences of the supplied water.

Water efficient tapware: Tested and labelled with their water efficiency rating.

Thermostatic mixing valves

Requirement: Provide thermostatic mixing valves that automatically control the temperature at the mixed outlet to a pre-selected temperature and suitable for the number of outlets served by the individual valve.

Temperature setting: To the minimum of 48 °C or Building Regulations Part G for baths unless otherwise nominated or required by the Controlling Authority.

Controls: Incorporate the following:

- A temperature sensitive automatic control that maintains temperature at the pre-selected setting and rapidly shuts down the flow if either supply system fails, or if the normal discharge water temperature is exceeded.
- Hot water flush facility.
- Valves: Provide strainers, check valves and isolation valves on water supply inlets.

Wall box: House the thermostatic mixing valve in a stainless steel recessed wall box with a hinged door and keyed lock.

Alternative location: Locate the thermostatic mixing valve in an alternative location (e.g. ceiling space) only where nominated. Position the valve to enable regular maintenance and coordinate means of access (e.g. access panel).

Upstream pipework: Provide at least one metre of pipework between a thermostatic mixing valve and the water heater supplying it.

Downstream pipework: Provide at least one metre of pipework between a thermostatic mixing valves and the outlets it supplies.

Integral devices: Provide thermostatic mixing valves integrated into tapware where nominated.

Buildcert TMV3 approval: Required.

NHS D08 model engineering specification: Required.

3 EXECUTION

3.1 INSTALLATION

General
Requirement: Install to manufacturer's recommendations. Use manufacturer's recommended tools and templates.

Location
General: Locate to dimensions as documented.

Installation
General: Install level, plumb and true to line in the required location. Make sure moving parts function freely and without obstruction. Do not modify supplied units.

Seal: Provide resilient seals between fixtures and backnuts.

Fixing: Provide rigid fixing for tapware so that it does not move in normal operation.

Cutting and fitting
General: If it is necessary to cut and/or fit substrate to install an item, carry out before the surface is finished or painted. Remove items when required for painting and protect until reinstalled. Cap or plug the open ends of pipes. Reinstall items when painting and finishing is complete.

Tap positions
General: Locate hot tap to the left of, or above, the cold tap.

Installation of tapware and outlets:

- Provide and install tapware and outlets as specified in the Tapware Schedule.
- Fix all hot and cold taps and outlets within walls to lugged tees, elbows or breaching pieces with approved anchors. Chrome plate all exposed pipes and fittings or finished as specified otherwise.
- Locate breeching pieces so that bonnets and spindles project the correct distance from the wall and panel face, and tap bodies are readily accessible for maintenance.
- Unless specified otherwise, provide all taps, outlets and associated fittings with matching finishes.
- Provide isolation valves on the water supplies to all tapware to allow for ease of maintenance and removal. Make sure isolation valves are of a type that does not restrict the water supply to the tapware.

Hose taps: Provide as specified and conform to the following:

- When installed in plant rooms and service areas, use 15 mm with 20 mm hose ruff, and with stainless steel wall plates, unless specified otherwise.
- When installed in toilet areas, use 15 mm chrome plated and install with stainless steel wall plates 600 mm above floor level unless otherwise noted.
- When installed in loading docks, car parks and similar areas, use 20 mm vandal resistant loose key type.
- Provide all hose taps with vacuum breakers.
- Provide an isolation valve on the water supply within 300 mm of the hose tap or as near as practicable that provides an accessible location.

3.2 COMPLETION

Adjustment
General: Inspect and adjust tapware for correct and smooth operation. If adjustment does not rectify incorrect or defective operation, replace units.

Damage
General: Inspect all work and replace or repair to factory condition damaged or marked fixtures and components.

Foreign matter: Inspect for presence of foreign matter particularly on tap seats. Remove if found. Replace damaged seats.

Protective coatings
General: On completion of the tapware installation remove all protective coatings and stickers and clean surfaces. Check and clean debris from traps.

Thermostatic mixing valves
Field testing: To BS EN 1287.

Maintenance: Conform to the *0891A Public health maintenance* worksection.

4 SELECTIONS

4.1 TAPWARE

General
Requirement: Conform to the tapware schedule produced by the Architect.

4.2 THERMOSTATIC MIXING VALVES

Approved manufacturers
General: Select from:
- Crane Fluid Systems.
- Horne Engineering.
- Pegler Yorkshire.
- Reliance Water Controls.

0813 WATER HEATERS

1 GENERAL

1.1 RESPONSIBILITIES

General
Requirement: Provide water heaters as documented.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following worksection(s):

- *0171 General requirements*.
- *0801A Public health systems*.

1.3 STANDARDS

General
Heated water services: To BS EN 806.

Indirectly heated unvented storage heaters: To BS EN 12897 Water supply. Specification for indirectly heated unvented (closed) storage water heaters.

Thermostats: To BS EN 257 Mechanical thermostats for gas-burning appliances.

Storage vessels: To BS 853-1 Specification for vessels in use in heating systems. Calorifiers and storage vessels for central heating and hot water supply.

Temperature and pressure relief valves: To BS EN 1490 Building valves. Combined temperature and pressure relief valves. Tests and requirements.

Temperature relief valves: To BS 6283-2 Safety and control devices for use in hot water systems. Specifications for temperature relief valves for pressures from 1 bar to 10 bar.

Authorised products
Standard: Listed in the WRAS Product and Materials Directory of approved products and materials, unless otherwise required by the Network Utility Operator or approved by the Engineer and Controlling Authority.

Microbial control
Standard: To HSE ACOP L8.

1.4 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:

- CFC: Chlorofluorocarbon.
- HCFC: Hydrochlorofluorocarbons.

1.5 SUBMISSIONS

Certification
General: Submit evidence that proposed components are listed in the WRAS (Water Regulations Advisory Scheme) Database.

Warranties
General: Submit warranties. Make sure that the Principal is named in any warranty that extends beyond the end of the defects liability period.

2 PRODUCTS

2.1 GENERAL

General
Requirement: Provide water heaters with the specified capacities and all necessary utilities, piping, valves, control system and fixings to allow autonomous operation of the water heaters.

External water heaters: Provide external water heaters that are specifically designed for external use by the manufacturer.

Assembly and testing: Factory assemble and test all water heaters including heating components and controls.

Cathodic protection: Incorporate anodes for cathodic protection in vitreous enamel lined steel vessels.

Earth bond: Make sure all vessels are earth bonded.

Overflow trays: Proprietary overflow trays with 25 mm of separation from the tray pan to the storage unit or 100 mm x 25 mm treated hardwood battens under each storage hot water unit. Trimmed neatly to length. Place battens parallel with one another and evenly place to support the entire water storage system.

Configuration

Heating capacity: Add standing losses to specified heating capacity unless agreed otherwise with the Engineer. Calculate standing losses from the water heater and distribution system.

Multiple water heater installations: Interconnect multiple water heater installations in a reverse return configuration to ensure even water flow through all units. Where even flow through units is not able to be achieved, provide additional balancing measures to achieve even flow distribution.

Operating pressure and temperature: Ensure the operating pressure and temperature of water heaters is suitable for the design operating pressure of the heated water distribution system.

Storage temperature: Store hot water at a minimum of 60 °C.

Insulation

General: Insulate and metal clad heated water storage systems.

Prohibition: Do not provide insulation materials that use CFC or HCFC as blowing agent during the manufacturing process.

Valves

Pressure and temperature relief valve(s): Provide pressure and temperature relief valves on all water heaters where heating can occur without the discharge of water from outlets. Select/set pressure and temperature relief valves to protect the water heater and distribution system from overpressure conditions for the maximum possible heat input.

Cold water expansion valve(s): Provide cold water expansion valve/s for the hot water generation system downstream of non-return valves. Size to meet the maximum heating input provided to the system.

2.2 COMMERCIAL CALORIFIERS AND HEATED WATER STORAGE VESSELS

General

Heating system:

Packaged domestic hot water calorifiers heated by air source heat pump provided by Mitsubishi Heavy Industries.

Capacity: Integrate with heating sources using heat exchanger(s) and piping connections to achieve the design heating capacities. Size heat exchangers to achieve the specified heat transfer rates with the vessel contents at 15 ^{o}C below the system set-point.

Over-temperature protection: Required, fail-safe type.

Vessels: Provide cylindrical vessels, as documented in the **Heated water storage container schedule**, consisting of shell, insulation and outer casing, with water feed, connected to the heating unit by the primary flow and return circuit, and provided with connections, fittings and controls necessary for its proper functioning.

Installation: Install Calorifiers in a UV and weather protecting shelter.

Pressure vessels

Standard: To PD 5500 (published document) Specification for unfired, fusion welded pressure vessels and EN 13445 Unfired pressure vessels.

Requirement: European Pressure Equipment Directive (2014/68/EU)

Test certificate: Provide where required by the Controlling Authority.

Shell material

Stainless steel: To ASTM A240/A240M type 2205 (duplex stainless steel).

Jointing

General: Weld by the inert gas shielded arc process using filler rods of the parent metal. Use suitable pickling and passivation methods on welds in stainless steel.

Insulation

Material: Insulate the whole of the vessel in mineral wool or polyester blanket.

Mineral wool insulation: Bio-soluble and not listed as a hazardous material in the Safe Work Australia Hazardous Chemical Information System (HCIS).

R-value of insulation: Minimum 1.0 m^2. K/W.

Installation: Wrap insulation around the whole of the tank or vessel with joints tightly butted. Form ends with cut segments of insulation to match the contours of the tank or vessel.

Fixing: 12 x 0.55 mm metallic-coated sheet steel straps at 500 mm maximum centres.

Prohibition: Do not use insulation containing chlorides in conjunction with stainless steel.

Casing

Material: Minimum 0.55 mm metallic-coated sheet steel coating class Z 275.

Installation: Cut and roll metal sheathing to the correct sizes. Lap longitudinal and transverse joints a minimum of 40 mm and arrange longitudinal laps to shed water, with exposed edges swaged.

Fixing: Clamp sheathing with 12 x 0.55 mm metallic-coated sheet steel straps at 500 mm maximum centres.

Fittings

General: Include the following:

- Full way drain with valve and hose connection for draining the container.
- Cold water connection 100 mm above bottom, fitted with inlet sparge pipe.
- Flow and return connections.
- 150 mm mercury-in-steel type thermometer. Mount in an easily readable position. Install in a fitted pocket and mount on a threaded chromium plated brass hexagon socket so that the sensing stem extends for its full length into the vessel. Provide a separate thermometer pocket or universal pressure/temperature test plug beside it so that the thermometer calibration can be verified in situ.
- Pressure gauge, 150 mm Bourdon type, mounted in an easily readable position.
- Temperature sensor port for the control of heating.
- Temperature sensor port for over-temperature cut-out sensor.
- Vacuum breaker.

Pipe connections

Pipe ≤ DN 50: Screwed sockets with unions.

Pipe > DN 50: Flanged, extended 50 mm clear of the insulation casing.

Flanges:

- Standard: To BS EN 1092-1.
- To copper alloy shells: Brass, with copper alloy bolts to ISO 197-3 designation C 65500.
- To stainless steel shells: The same material as the shell.

Cathodic protection

General: Provide an anode or anodes inside the vessel in a readily removable location within reach of an access opening.

Personnel access

General: Provide a bolted flanged cover fitted with a gasket, or a cover fitted with a gasket and clamping bar.

Size: 400 mm minimum diameter access hole.

Mounting

General: Mount the vessel on a fabricated mild steel cradle or base ring.

Cradle: Insert 1.5 mm fibreglass woven tape between vessel and cradle.

Base ring: Provide the same material as the vessel for the portion of the ring in contact with the vessel.

Clearance: Minimum of 300 mm between the finished surface of the insulation and the floor.

Warranties
Warranty period: Minimum 20 years at the design working pressures, temperatures and water composition.

2.3 HEAT PUMP WATER HEATERS

General
General: Provide a proprietary automatic water heater comprising heat pump system and storage vessels, including connections, controls and necessary fittings.

Heating system: Heat pumps with additional electric immersion heating element(s) prewired with thermostats.

Over-temperature protection: Surface mounted thermostat incorporating a safety over-temperature cut-out.

Coefficient of performance: Minimum 3.25 at 15 °C ambient temperature.

Operating ambient temperature range: -10 °C to 42 °C.

Efficiency for immersion heating: Minimum 99%.

Delivery temperature: Minimum 60 °C.

De-icing: Required.

Description
Corrosion protection: Provide sacrificial anodes in each steel storage vessel as documented in the **Heat pump water heater schedule**.

Refrigerant: Carbon Dioxide

Standard
General: To BS EN 378-4

Performance evaluation: Energy efficiency class A+.

Warranties
Warranty period:

- Cylinder: Minimum 5 years.
- Sealed refrigeration system: Minimum 2 years.

3 EXECUTION

3.1 INSTALLATION

General
Standard: Install to BS EN 806.

Heat pump water heaters
General: Make sure that free air flow around and above the heater is not obstructed and that discharge air does not short circuit to the air intake.

Manifolds
General: If multiple heaters are installed in banks use the manufacturer's standard manifold arrangement to provide equal flow thorough each heater in the bank.

4 SELECTIONS

4.1 WATER HEATERS

Water heater schedule

Property	
Water heater type	Heat pump
Approved manufacturers	Mitsubishi Heavy Industries

Models: A listing as an approved manufacturer does not imply that all models from that manufacturer are acceptable.

0814A PUBLIC HEALTH PUMPS

1 GENERAL

1.1 RESPONSIBILITIES

General

Requirement: Provide pumps as documented.

Duties: Check and recalculate all pump duties against the final system configuration and installation.

Pumps with variable speed drives: Select so the documented performance is achieved at 50 Hz.

Noise level: Less than 70 dB(A) at 1 m from the pump.

1.2 CROSS REFERENCES

General

Requirement: Conform to the following worksection(s):

- *0171 General requirements*.
- *0801A Public health systems*.

1.3 INTERPRETATION

Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

- WRAS: Water Regulations Advisory Scheme.

1.4 STANDARDS

General

Standards: To BS EN ISO 9906.

Authorised products

Standard: Listed in the WRAS Product and Materials Directory of approved products and materials, unless otherwise required by the Network Utility Operator or approved by the Engineer and controlling authority.

1.5 SUBMISSIONS

Products

Type tests: Required.

Standard: To BS EN ISO 9906.

Accuracy of measurement: Grade 2 to BS EN ISO 9906.

Type test records: Submit type test curves for each size and type of pump marked with the duty point.

Technical details: Provide all technical details of pump systems to the Engineer for approval prior to the purchase of equipment.

Certification

General: Submit evidence that proposed system is listed in the WRAS Product and Materials Directory of approved products and materials.

2 PRODUCTS

2.1 COMPONENTS

Control panels

General: Provide control panels to suit the controls. Mount switches, and indicating lights on the door. Mount motor starters, relays and switchgear and terminals on DIN rails inside the cabinet. Run cables in trunking or looms.

Labelling: Label all components. Number both ends of each cable and number terminal strips to match the circuit diagram. Provide a laminated circuit diagram inside the cabinet.

Metalwork: Vandal proof cabinet constructed from metallic zinc coated steel with powder coat finish. Provide a hinged and lockable door with 2 keys.

Protection: Degree of protection IP54 or better.

Manual operation: Provide the ability to manually operate the pump.

Power failure: Pumps must restart automatically after power failure.

Warning lights: Provide lights to indicate power available, run for pump, fault for pump and other faults.

Controls – dual pump installations

General: Provide controls to alternate the pumps after each cycle of operation, start the idle pump if the other fails, and activate an audible alarm and a flashing warning light to indicate a failure.

Alarm bells: Mount on an external wall. Provide alarm mute.

Meters: Provide an hours-run meter to each motor.

Selector: Provide an auto-off-on selector for each pump.

Warning lights: Provide separate lights to indicate power available, run for each pump, fault for each pump and other faults.

Float switches

Type: Micro switch. Provide one level switch for each liquid level to be detected.

Construction: Double encapsulated hermetic construction designed for long life submerged. Provide a clamp to permit accurate adjustment of levels.

Cable: Low moisture absorption type.

Liquid pressure sensor

Type: Pressure transducer.

Construction: Hermetic construction designed for long life submerged.

Cable: Low moisture absorption type.

Marking

General: Provide a robust label on each pump or pump set showing design flow rate, head, temperature of pumped medium, casing, impeller and shaft materials.

Motors

Dimensions and performance: To IEC 60072-3.

Installation:

Motors Minimum 0.75 kW: Three phase, flange mounted.

Overload protection: Provide each motor with overload protection.

Performance:

- Efficiency: Motors documented as premium efficiency to IEC 60034-30-1 , all other motors to high efficiency.
- Power factor at full rated output: Minimum 0.72 for single phase motors, minimum 0.83 for three phase motors.

Selection: Provide motors selected for the maximum number of starts per hour of the installed system and to provide efficient, non-overloading pumping sets.

Power rating: At least the maximum power required by the pump when projecting the system resistance curve to the maximum impeller size for the pump casing size.

Degree of protection: IP54 or better.

Shaft: If the impeller is mounted directly on the motor shaft use grade 416 stainless steel for the shaft.

Gauges

Pressure: Provide a pressure gauge to indicate the pressure at the inlet and outlet of the system.

Temperature: Provide a temperature gauge to indicate the temperature at the inlet and outlet of the system.

Electrical installation

See work section *0882A Public health electrical - minor* clause **ELECTRICAL INSTALLATION.**

Motors and drivers

See work section *0882A Public health electrical - minor* clause **MOTORS AND DRIVERS.**

Pressure vessels

Standard: To PD 5500 (published document) Specification for unfired, fusion welded pressure vessels and EN 13445 Unfired pressure vessels.

Requirement: European Pressure Equipment Directive (2014/68/EU)

Type: Diaphragm pressure tanks of fabricated steel construction, epoxy coated on metal surfaces in contact with water. Precharge the tanks with air.

Valves:

Non-return valves: Provide on the discharge side of each pump.

2.2 PUMPS – IN-LINE CIRCULATING

General

Requirement: Comply with the requirements for **Pumps – END-suction centrifugal** except as follows.

Mounting: Suitable for mounting with the shaft vertical or horizontal.

Impellers: May be fixed to the motor shaft.

Radial bearings: Ceramic sleeve or ball bearing.

Axial bearings: Carbon/ceramic sleeve or ball bearing.

Pump housings: Cast iron or bronze.

Casing arrangement: Back pullout.

Sealing: Seal motors and electrical connections to protect against ingress of condensation.

2.3 PUMPS – HEATED WATER CIRCULATING

General

General: In-line circulator pump and motor with bronze housing and stainless steel or non-ferrous corrosion-resistant wetted parts.

Bearings: Ceramic self-lubricating type for low noise running.

Temperature: Suitable for continuous 24 hour operation with heated water in the range of 2 ^{o}C to 100 ^{o}C.

Inlet pressure: Where operating at static water pressure less than 25 kPa with circulation pressure loss greater than 50 kPa, provide piping connections to increase pressure at the inlet of the pump with high flow by-pass arrangement to eliminate cavitation.

Valves: Provide isolation valves to enable the removal of individual pumps without interruption to system operation.

Controls

Control: Provide time clock for after hours control. Provide a pressure switch to sense excessively low suction pressure, shut down the pumps and signal an alarm.

Manual reset: Provide manual reset.

Speed control: Provide pump with duties greater than 1.0 L/s with variable speed drives (VSDs). Provide temperature sensor integrated with controls to set pump duty. Where duties are less than 1.0 L/s, provide manual speed selection (minimum of 3 speeds).

Alarm: Indicate faults with an audible and visual alarm.

Monitoring systems: Transfer fault and well level information as displayed on the control panel to the monitoring system provided by others.

Single circulating pump

General: Provide a pump and with in-built controls to maintain heated water circulation.

Construction: Factory-assemble the unit with pump, pressure vessel, control panel and ancillaries on steel frame mounted on steel baseplate.

Dual circulating pump

General: Provide a dual system consisting of two identical pump and motor sets and operated by an interconnected automatic control mechanism to maintain heated water circulation..

Construction: Factory assemble the units with pumps, pressure vessels, control panel and ancillaries on steel frames mounted on steel baseplates.

2.4 WATER SUPPLY PRESSURE BOOSTER SYSTEM

General

General: Provide automatically controlled self-priming multi-stage centrifugal pumps.

Turnkey packaged systems: Unless specified otherwise, provide pumping and pressurisation systems that are turnkey packaged systems with integrated local control systems with the capability to interface to other monitoring systems.

Selection: Select pumps suitable for the water supply quality, pressure and temperature conditions.

Noise and vibration: Minimise noise and vibration, using anti-vibration mountings and flexible couplings on both sides of the pump.

Casings: Provide all pumping systems, unless specified otherwise, with stainless steel or cast iron casings with screwed connections up to 50 mm diameter and flanged connections for 65 mm and above. Construct for a life of not less than 100,000 hours continuous operation.

Operating conditions: Provide all pumps suitable for the anticipated operating conditions.

Pump assembly: Balance all pump assemblies and include mounting systems that mitigate vibration transfer to supporting structure and connected piping systems.

Piping assembly: Connect the piping assembly to pumps installed so that no load is imposed on the pump casing. Separately support all pipework.

Union or flanged connections: Fit union or flanged connections on the suction and discharge lines to allow for removal.

Support pipework: Support pipework so that pumps can be removed without disturbing valves and connections. Arrange multi-pump assemblies to enable single pumps to be removed without impacting on the operations of other pumps.

Degree of protection: Make sure all pumps and related electrical equipment have a degree of protection in accordance with the relevant Standard (refer to clause **GENERAL** sub clause **Standards**) relative to the installation location.

Single pressure booster system

General: Provide a pump, motor and pressure vessel package with in-built controls to maintain the pressure at the pump discharge between the maximum and operating pressures.

Construction: Factory-assemble the unit with pump, pressure vessel, control panel and ancillaries on steel frame mounted on steel baseplate.

Dual pressure booster system

General: Provide a system consisting of two identical pump and motor sets, each serving its own pressure vessel and operated by an interconnected automatic control mechanism.

Arrangement: Provide valving so that couplings between the pumping system and the distribution system can be replaced without terminating water supply to the facility (i.e. duplex connections to inlet and outlet manifolds with valving to suit).

Construction: Factory assemble the units with pumps, pressure vessels, control panel and ancillaries on steel frames mounted on steel baseplates.

Controls: Provide a pressure switch to sense excessively low suction pressure, shut down the pumps and signal an alarm. Provide manual reset.

Multi pump pressure booster

Pumps: Provide boosters consisting of multiple identical pumps arranged in parallel feeding a common header. Provide public health and electrical isolation to each pump.

Pressure vessels: Provide two pressure vessels sized to reduce pump cycling. Connect each to the header each with separate isolation valve.

Maintenance: Make sure that all public health components can be replaced without interrupting water supply to the facility.

Control: Maintain the pressure setpoint downstream of the booster.

Proprietary unit: Deliver the complete booster system to site as a proprietary unit mounted on a steel baseplate.

Back flow: Provide check valves to prevent back flow through non-operational pumps.

Fault monitor: Sense excessively low suction pressure, shut down the pumps and signal an alarm. Provide manual reset.

Controls

General: Provide controls for the system as follows:

- Start pumping when the pressure drops below setpoint.
- Stop pumping when the pressure is above setpoint.
- Start additional pump(s) when pressure drops below setpoint.
- Automatically alternate between pumps for even wear.
- Automatically operate alternate pump(s) upon failure of a pump.
- Operate multiple pumps where this reduces overall energy consumption.
- Stop pumping after 3 minutes of when operation of all pumps fails to achieve pressure setpoint (indicative of a major leak).
- Automatically adjust pump speeds to maintain pressure within a range of 50 kPa about the setpoint in response to varying demand.
- Stop pumping when water supply is unavailable (e.g. tank at low level) (dry-run protection).
- Provide pressure sensors for each pump so that a failure of any single sensor does not impact on the ability of the system to continue to operate.
- Is capable of continuing the operation of the system if a single pressure sensor fails.
- Raises an alarm when pressure sensors (1 per pump) read a differential of more than 100 kPa.
- Logs the occurrence of faults (with date and time stamp for each fault).
- Logs the operation of pumps and provides trending information.
- Enables automatic and manual operation.
- Dry-run protection on manual operation.
- Where pumps are controlled by the level within remote tanks (e.g. high level tanks/reservoirs), provide the functionality to operate as a pressure controlled system so that pump operation can continue if the communication between tanks and pumps fails.

Level sensor precision: Minimum 2% volume increments.

Levels readout: Indicate the level within each tank (where applicable) in minimum 10% increments with numeric readout at the control panel.

. Alarm: Indicate faults with an audible and visual alarm.

Monitoring systems: Transfer fault and tank level information as displayed on the control panel to the monitoring system provided by others. If no monitoring system is provided by others, provide a mobile data telephony system to relay faults to selected email addresses and phone numbers.

Speed control: Provide variable speed drives (VSDs) by varying frequency.

Pressure gauges

General: Provide pressure gauges on the inlet and outlet of each pumpset manifold.

Automatic tank to mains changeover controls

General: If recovered water including rainwater is used as an alternative supply to mains water, provide automatic changeover controls.

Operation: Use mains water when the water level in the storage tank is below set level or otherwise unavailable, demand is low or would cause excessive pump starts. In all other cases use stored water.

Inclusions: Provide low voltage water level switch, dual check valves or reduced pressure zone device to prevent cross connection and motorised valves for mains and stored water changeover and all associated wiring and controls.

3 EXECUTION

3.1 INSTALLATION

Standards

Hot and cold water service pumps: Install to BS EN 806.

Wastewater pumps: Install to BS EN 12056.

Stormwater pumps: Install to BS EN 12056.

Connections

General: Arrange pumps, piping and valves so that individual pumps can be removed with minimal drain down and disturbance to the connected piping. Support pipes independently of pumps.

Connections: Install vibration isolating couplings in the connecting pipes at the pumps. Provide couplings selected for a working pressure at least twice the system design pressure.

Vibration mounts

General: Provide corrosion-resistant anti-vibration mounts under each pump. Alternatively, if the pumps are installed on a baseplate the mounts may be installed under the baseplate.

Pressure tappings

General: Provide a pressure tapping on the inlet and discharge of each pump.

Fixing

General: Fix all pumps and pump sets to the supporting structure. Use expanding shield anchors for concrete.

Mounting

General: Mount and align each pump and motor correctly. Factory check the pump alignment.

Pump assemblies: Balance all pump assemblies and include mounting systems that mitigate vibration transfer to supporting structure and connected piping systems.

3.2 COMPLETION

Commissioning

General: Commission to the manufacturers' recommendations.

Packaged pump systems: Commission all pumping systems once they are installed by a qualified representative of the manufacturer. Provide a commissioning report detailing all set points and confirming that the pump set has been commissioned in accordance with the required operating parameters.

Alignment: Arrange for the pump supplier to verify by inspection on site that the alignment is correct after the pumps have been placed in position with pipe connections made and piping filled with water.

Testing: Obtain independent tests of flow rate and duty through independent devices including water meters and pressure sensors/gauges. Include pressure testing under closed head conditions.

Duty range: Where pumping systems are expected to operate over a range of duty points, field test by initiating fluctuating field demands.

Report: Provide a commissioning report detailing all set points and confirming that the pump set has been commissioned in accordance with the required operating parameters.

Testing

General: Provide the following tests for each pump and pump set before the date for practical completion:

- Pump operation: Test for correct pump rotation and operation.
- Automatic changeover: Test changeover sequence under all operational combinations.
- Level controls: Operate pumps, measure levels and adjust if necessary. Verify level sensing systems (the level sensor may be temporarily adjusted manually to initiate necessary system start up and fault. alarms).
- Discharge outlet pressure and flow.
- Verification of time clock operation and settings.
- Undertake the manual operation of the system without shut off to confirm that extended manual operation does not compromise the system (i.e. the system terminates operation prior to running the system critically low/dry).
- Verify that secondary systems such as macerators and agitators are operating during a filling/pre extraction cycle.
- Safety controls: Simulate fault for each safety control.
- Alarms: Simulate alarm condition. Verify correct alarm raised.
- Motors: Measure motor current and adjust motor overloads to suit.

Completion test: Provide a full operational test to verify compliance.

- Pumping and assisted stormwater transportation: Fill pumping systems to initiate an operational cycle of the system to verify the following:
  . Discharge outlet pressure and flow.
  . Cycling and staging of primary, secondary and other relevant systems.

. Verification of level sensing systems (the level sensor may be temporarily adjusted manually to initiate necessary system start up and fault. alarms).
. Undertake the manual operation of the system without shut off to confirm that extended manual operation does not compromise the system (i.e. the system terminates operation prior to running the system critically low/dry).

Documentation

General: Provide testing and commissioning sheets and report.

Manufacturer tests: Where a specific testing procedure is prescribed by the manufacturer, adhere to this procedure and document testing and commissioning results in the Quality Assurance file.

4 SELECTIONS

4.1 SCHEDULES

Pump manufacturers schedule

Acceptable manufacturers: Provide pumps from one of the following manufacturers:
Pumps - Heated Water Circulating
- Grundfos.
- Lowara (Xylem).
- Wilo.

Water Supply Pumps
- Grundfos.
- Lowara (Xylem).
- KGN Pillinger.

Water Supply (Category 5 and rain water harvesting system) Tank and Pumpset
- Grundfos.
- Lowara (Xylem).
- KGN Pillinger.
- Aquality Trading & Consulting Ltd

0821 STORMWATER – BUILDINGS

1 GENERAL

1.1 RESPONSIBILITIES

General

Requirement: Provide stormwater installation, as documented. Provide stormwater and roof drainage systems that include all necessary sub-systems to service the development. Install all stormwater and roof drainage systems in accordance with the requirements of this specification and the Controlling Authority.

Treatment: Where required by the Authority, treat storm water in accordance with the requirements of the Controlling Authority prior to outfall into the local infrastructure system.

Stormwater and roof drainage systems: Provide the stormwater and roof drainage systems to convey stormwater to the authority outfall or designated interface points with existing systems or systems provided by others.

Architectural documentation: Refer to the Architectural documentation for finishes, materials and details of exposed services.

Structural documentation: Refer to the Structural documentation for below ground drainage design.

Size and install components: Size and install all components of the system(s) to minimise/prevent the incidence of blockages and to prevent ingress to internal areas and overfilling/overtopping of the system.

Rainfall intensity: Base the designed rainfall intensities upon substantiated meteorological rainfall data and select to appropriately address the risks imposed by a system overfilling/overtopping. Local metrological service rainfall intensity data that exceeds the data published by the Controlling Authority takes precedence.

Performance based solutions and guarantees: Take full responsibility for all performance based solutions and provide written guarantees to that effect.

Storm water and roof drainage components: Install all storm water and roof drainage components in accordance with the manufacturer's recommendations. Submit any installation advice contrary to this specification to the Engineer for approval.

Discharges: Make sure that discharges from dissimilar metals do not adversely affect downstream components.

1.2 CROSS REFERENCES

General

Requirement: Conform to the following worksection(s):

- *0171 General requirements*.
- *0801A Public health systems*.

1.3 STANDARDS

Approved documents

Drainage and Waste Disposal: Part H of Schedule 1 to the Building Regulations 2010.

Stormwater drainage

Standard: To BS EN 752.

Roof drainage

Standard: To BS EN 12056.

1.4 INTERPRETATION

Definitions

General: For the purposes of this worksection the following definitions apply:

- Embedment material: Includes bedding, haunch support, side support and overlay material.
- Pipe surround: Includes pipe overlay, pipe side support, side zone and haunch zone.

General: For the purposes of this worksection the definitions given in the *General requirements* worksection apply.

Abbreviations

General: For the purposes of this work section the following abbreviations apply:

- LED: Light emitting diode.

1.5 SUBMISSIONS

Certification

Pre-completion tests: Submit results from pre-completion leak testing.

Certification: Submit certificate stating that network is leak free upon completion.

Certification: Submit certificate stating that network is pressure tested and witnessed upon completion for sections required to undergo pressure testing.

Warranties

Submit warranty.

1.6 INSPECTION

Notice

Inspection: Give notice so that inspection may be made at the following stages:

- Concealed or underground services prior to being covered.
- Upon completion.

2 PRODUCTS

2.1 MATERIALS

Piping

Requirement: As documented in the **Stormwater pipeline schedule**.

Joints

Solvent cement and priming fluid.

Linear drains and grates

Requirement: As documented.

Installation: Conform to manufacturer's recommendations.

Rainwater outlets

Requirement: Provide proprietary rainwater outlets to roof and balcony areas and as documented.

Size: 100 mm diameter or as documented.

Filter material

General: Provide filter materials consisting of natural clean washed sands and gravels and screened crushed rock conforming to BS EN 752.

Embedment material

Stormwater drains: Conform to BS EN 752.

Subsoil drains: Conform to BS EN 752.

2.2 STORMWATER AND ROOF DRAINAGE INLETS

General

General: Select roof inlets other than where sumps are provided to achieve the design flow with a maximum water head of 50 mm. Make sure inlets serving balconies, paved areas and the like achieve the design flow with a maximum water head of 25 mm above grate level unless detailed otherwise. Coordinate with other trades to ensure that this head of water does not cause ingress into the building. Provide larger or additional inlets if this cannot be achieved.

Certified testing data: Provide certified testing data to demonstrate that design flows are achievable through selected inlets.

Inlets: Provide inlets approved for use with the specified water proofing system.

Install inlets: Install inlets strictly in accordance with the manufacturer's recommendations.

Provide inlets that conform to the following:

Conventional stormwater inlets - roof

General: Provide approved roof inlets that have funnel shaped roof drains with mechanical joint complete with dome grate and fixing bolts.

Balcony inlets: Provide approved balcony inlets that have funnel shaped drains with mechanical joint and complete with flat grate.

2.3 STORMWATER DETENTION TANKS

General

Requirement: Provide structurally sound tanks conforming to BS EN 752.

Openings: Design to resist human loading forces and to prevent the inappropriate entry of humans, animals, insects, surface water, ground water and rubbish.

Accessories: Provide all accessories needed to complete the installation, including the following:

- Inlet and outlet connections.
- Tight fitting lids or screens with maximum 1 mm mesh at all openings.
- Flap valves at every opening to the tank.
- Calmed inlet to the tank to prevent stirring sediment.

Accessory materials: Select from:

- Ultraviolet light resistant plastic.
- Corrosion resistant metal. Do not use copper or copper alloys with metallic coated steel tanks.
- The same material as the tank.

Access opening: Provide a vermin proof, child proof access opening above the high water level and cover with either a strainer or a lid fixed securely to the tank.

Warranties

Requirement: Provide a manufacturer's warranty for the tanks.

Connections

General: Reinforce the tank wall to resist loads imposed by the connected piping.

Polyethylene tanks

Standard: To BS EN 12573.

Coated steel tanks

Roof: Flat with supporting structure.

Jointing: Conform to the recommendations of the metallic-coated steel manufacturer.

Material: Conform to the following and the **Coated steel tanks material table:**

- Top and sides: Metallic-coated steel with polymer film on the inside and prepainted on the outside.
- Base: Metallic-coated steel with polymer film on inside and outside.
- Corrugated steel sheet.

3 EXECUTION

3.1 PIPING

General

Laying: Lay lengths separately with the barrel bearing evenly on the prepared bedding.

Sockets: Lay with sockets pointing upstream.

Cleaning: Clean pipe interior of dirt, debris, mortar and other foreign matter.

Cut pipes: Remove burrs and swarf from cut pipes and prepare all joints in line with manufacturer's recommendations prior to joining.

Protection: Provide temporary caps over the ends of incomplete sections to prevent the entry of foreign matter.

3.2 OVERFLOW DRAINAGE

General

General: Provide separate overflow systems for every stormwater collection system (this may be independently piped, channelled, or by surface flows). Match or exceed the capacity of overflows to that of the stormwater collection system.

Overflow system: Make sure that the overflow system is completely separate to the primary stormwater collection system and discharges in a clearly noticeable location without causing ingress to the building.

Installation: Install the overflow system in a manner to prevent ingress of rain water into the building in the event of blockage of the primary stormwater system.

Overflow inlets: Set overflow inlets at a minimum of 50 mm above the top of the applicable primary stormwater system inlet whilst maintaining 50 mm freeboard from overtopping when the overflow system is performing at design levels. Coordinate with other trades to ensure that gutters, flashings, and surfaces are formed to achieve the public health drainage and head pressure/gradient line strategies to be employed.

3.3 DOWNPIPES AND STORMWATER RETICULATION

General

General: Install downpipes plumb unless detailed otherwise.

Installation locations: Install downpipes in exposed locations so that manufacturer's markings are turned away from the visible face, but in concealed situations (ceiling voids, ducts and the like) make sure the manufacturer's markings are visible prior to installation of linings.

External downpipes: Provide external down pipes in locations and finishes as specified by the Architect. Resolve any discrepancy with the Architect's documentation with the Engineer prior to installation.

Proprietary fittings: Provide proprietary fittings (e.g. junctions and bends) unless documented otherwise.

Protective films: Remove protective films as soon as practical after installation.

Sealing: Seal connections to outlets and stormwater reticulation.

Materials: Confirm materials selections are suitable for the conditions.

3.4 SIPHONIC ROOF DRAINAGE SYSTEM

General

General: Where specified, design, supply and install the Siphonic Roof Drainage System complete with inlets, rigid fastening/support system and piping network. Connect the siphonic drainage system to the stormwater drainage system and break the siphon.

Design and installation

General: Design and install the siphonic roof drainage system by accredited technicians using only licensed software suitable for the system being used. Allow for adequate longitudinal expansion and deflection.

Gutter sizes: Make sure the design nominates and coordinates gutter sizes required to accommodate siphonic priming time without gutter overtopping.

Gutter weights: Coordinate gutter weights based on system priming times to make sure the supporting structure is adequate for the design gutter loads.

Balancing of flows: Communicate and coordinate the balancing of flows with other trades to ensure the design flows per outlet are achieved.

Velocities: Maintain velocities as low as practicable to minimise noise generation but suitable for system balancing and minimising siphonic priming time.

Calculations and drawings

General: Provide complete public health calculations including a monogram, pipe dimensions, friction loss and flow velocity in pipes on 3D CAD and isometric drawings. Submit to the Engineer for verification and approval prior to commencing work.

Material

Materials: Select materials suitable for the range of maximum positive and negative pressures.

Markings on pipes and fittings: manufacturer's marking and relevant standard test marking.

Supporting system

General: Make sure the piping support system strictly conforms to all requirements of the siphonic design. Where spans between structural elements exceed specified clipping distances, provide additional support rails for the system as required. Make sure suspension systems cater for full pipe conditions.

Connection to stormwater drainage system
General: Connect the siphonic drainage system to the stormwater drainage system. Break the siphonic action at the connection to the stormwater drainage system. Increase the pipe diameter to suit the flow rate of the system (velocity to be less than 1.5 m/s). Alternatively, discharging to an inlet pit with grated lid or vent.

Testing and certification
General: Upon completion, submit the manufacturer's written 50 year guarantee, including the as constructed performance statement. Provide written certification to confirm the installation meets the manufacturer's requirements and has been installed using only genuine components. Provide certification by a qualified third party and performance based design information where required by the Controlling Authority.

3.5 STORMWATER DETENTION TANKS

Description
General: Provide storm water detention systems in accordance with the requirements of the controlling authority and any project specific sustainability initiatives.

Detention tank: Provide the detention tank with 100% overflow capacity of the catchment area. Discharge the over flow into the main stormwater drainage system or to the main outfall.

Discharge orifices: Size discharge orifices for throttling outflows in accordance with local authority requirements and make readily accessible for cleaning.

General installation
General: Provide structural support to withstand the mass of the tank when full without deformation or excessive settling.

Connecting piping: Support independently of the tank.

Above ground tank installation
Restraint: Restrain the tank to prevent movement, when empty, caused by wind and other loads.

Base: Provide a level base with gaps not exceeding 10 mm, free of sharp projections and projecting beyond the edge of the tank at all points.

Polyethylene tank support: Trim and compact the ground and place a level bed of sand at least 50 mm thick.

Coated steel tanks: Fully support tank on a self-draining timber or concrete base.

Coated steel tank corrosion protection:

- Prevent contact with dissimilar metals.
- Arrange so that no part of the tank is below ground level and so that adjacent ground surfaces fall away from the tank.
- Do not use sharp objects inside the tank. Remove swarf with a magnet if drilling or cutting.

Concrete tank support: Trim and compact the ground.

3.6 GENERAL ITEMS

Protection
General: Protect the drainage system from ingress of Contractor's debris and the like by temporarily capping open ends and providing filter cloth on inlets during the construction phase.

Suspension systems
General: Provide suspension systems capable of supporting piping systems in a flooded state. Provide appropriate fixings to connect into structural elements of the suspension system.

Supports: Provide supports spanning structural elements where fixing points at suitable centres cannot otherwise be obtained.

Acoustically treated suspension systems: Where required, provide acoustically treated suspension systems between structural and architectural elements to make sure the requirements of the acoustic report are achieved.

Expansion and contraction
General: Make sure that all components of the piping systems are installed to take in to account the effects of expansion and contraction without any detriment to the system and without visible distortion.

Pipework movement: Provide mechanisms to allow the pipework movement spanning seismic joints or gaps.

Exposed pipework

General: Finish all exposed pipe work in sensitive/open to view areas in accordance with the architect's requirements.

3.7 TESTING AND COMMISSIONING

Pre-completion tests

General: Before backfilling or concealing, carry out the following tests:

- Gutters, outlets and rainwater pipes: To BS EN 12056-3 Annex A and National Annex NE.
- Outside buildings: To BS EN 752.
- Rainwater pipes: Water test all rainwater pipes within buildings unless an alternative method is required by the Controlling Authority. Undertake water tests for a period of not less than 10 minutes to 10 metres head or the height of the rainwater pipe, whichever is the greater. Where the piping material properties are unable to accommodate the head pressure including tall buildings, undertake sectional testing.
- Pumped discharge lines: Make sure pump discharge lines are free from leaks when subjected to hydrostatic pressure equal to twice the shut off head of the pump or, if a relief valve is used, twice the pressure at which relief valves operate.

Leaks: If leaks are found, rectify and re-test.

Notification: Provide at least 48 hours notice in writing of the date and time proposed for all testing so that the Engineer, Contractor and/or authorised representative of the Controlling Authority may attend.

Apparatus: Supply all apparatus and materials necessary.

Quality assurance: Provide a Quality Assurance file containing test sheets recording the time and date of all tests carried out and keep on site to make available to the Engineer for review during site visits. Make sure the test sheets are signed by the Contractor responsible for conducting the test. A copy of all Controlling Authority sign-off sheets are also to be kept onsite in the Quality Assurance file.

Testing and commissioning

General: Carry out the following tests:

- Gutters and spouting: Flood test all gutters and spouting to the height of overflow. Visually inspect the full length of the gutter and all overflow connections for leaks. Undertake flood tests at a time where property damage protection measures can be implemented. Control all flooding activities.
- Pumping and assisted stormwater transportation: Fill pumping systems to initiate an operational cycle of the system to verify the following:
  - . Discharge outlet pressure and flow.
  - . Cycling and staging of primary, secondary and other relevant systems.
  - . Verification of level sensing systems (the level sensor may be temporarily adjusted manually to initiate necessary system start up and fault. alarms).
  - . Undertake the manual operation of the system without shut off to confirm that extended manual operation does not compromise the system (i.e. the system terminates operation prior to running the system critically low/dry).

Camera inspection

General: Upon satisfactory completion of hydrostatic and/or air testing, the Controlling Authority or Engineer may request an internal camera inspection of underground pipe work for visual evidence of straight alignment, flush internal jointing and obstructions.

Rejection: Reject pipework if the pipework does not appear to be aligned, have flush jointing or free of obstructions.

Documentation

General: Provide testing and commissioning sheets and reports for but not limited to the following:

- All pipe work.
- Pumping systems.
- Overflow systems operation.
- Flood testing.

Manufacturer test: Where a specific testing procedure is prescribed by the manufacturer, adhere to this procedure and document testing and commissioning results in the Quality Assurance file.

3.8 COMPLETION

Cleaning
General: Clean and flush the whole installation.

4 SELECTIONS

4.1 STORMWATER

Rainwater HDPE piping schedule
Provide HDPE pipe as follows:
- Size range DN 40 to DN 300.
- Manufactured by Geberit.
- Jointing by fusion welding (fusion couplings or butt jointing).

Stormwater cast-iron piping schedule
Provide cast-iron pipe as follows:
- Size range DN 75 to DN 300.
- Manufactured by Saint-Gobain Pam Systems (Ensign).
- Jointing by mechanical couplings.
- Standard: BS EN 877.

Downpipes (exposed)
Requirement: Conform to the Architect's requirements.
- Size range DN75 to DN 200
- Manufactured by Alumasc , type Harmer (Conform to the Architect's requirements)
- Jointing by mechanical couplings

Siphonic stormwater piping schedule
Provide HDPE pipe as follows:
- Manufactured by Geberit.
- Jointing by fusion welding, use fittings or butt joints.

Pumped lines polyethylene piping
Provide polyethylene pipe as follows:
- Size range DN 40 to DN 300.
- Classification: PN16.
- Manufactured by Polypipe or Geberit.
- Jointing by fusion welding (fusion couplings).

0822 WASTEWATER

1 GENERAL

1.1 RESPONSIBILITIES

General

Requirement: Provide sanitary plumbing and drainage as documented.

General: Provide the sanitary plumbing and drainage system comprising all necessary sub-systems to service the development. Install all sanitary plumbing and drainage systems in accordance with the requirements of this specification and the controlling authority. Provide the sanitary plumbing and drainage system to convey wastewater to the authority outfall or designated interface points with existing systems or systems provided by others.

Architectural documentation: Refer to the Architectural documentation for finishes, materials and details of exposed services. Alternatively, refer to work section *Treatment systems* and work section *General items* clause **IDENTIFICATION AND LABELLING**.

Components of the system: Provide all components of the system(s) sized and installed in a manner to minimise/prevent the incidence of blockages.

1.2 CROSS REFERENCES

General

Requirement: Conform to the following worksection(s):

- *0171 General requirements*.
- *0801A Public health systems*.
- *0811 Sanitary fixtures*.

1.3 STANDARDS

Authorised products

Standard: To the applicable standards unless otherwise required by the Network Utility Operator.

Approved documents

Drainage and Waste Disposal: Part H of Schedule 1 to the Building Regulations 2010.

General

Standard: To the applicable standards unless otherwise required by the Network Utility Operator.

Sanitary plumbing and sanitary drainage

Standard: To BS EN 12056-2.

1.4 SUBMISSIONS

Certification

General: Submit evidence that proposed product complies with the applicable standard.

Pre-completion tests: Submit results from pre-completion leak testing.

Certification: Submit certificate stating that network is leak free upon completion.

Certification: Submit certificate stating that network is pressure tested and witnessed upon completion for sections required to undergo pressure testing

1.5 INSPECTION

Notice

Inspection: Give sufficient notice so that inspection may be made at the following stages:

- Concealed services prior to being covered.
- Upon completion.

2 PRODUCTS

2.1 TRAPS AND GULLIES

General

Traps: As documented.

Location: If possible, conceal traps and wastes in the fabric of the building.

Gullies: As documented.

Inspection chambers and sumps

General: As documented and to BS EN 124.

3 EXECUTION

3.1 SANITARY PLUMBING

Location

General: Verify location and invert level of piping before commencing installation.

Layout: Arrange piping to conform to the documented layouts as follows:

- Avoid interference with other services and building elements not yet installed or built.
- Follow the most direct route with the least number of changes of direction.

Ducts: If installed in ducts, locate and fix stacks, wastes and pipes independently of other services. Arrange so they are easily accessible and removable throughout their entire length.

Piping: As documented in the **Sanitary plumbing piping schedule**.

Pipe work grade: Unless specified otherwise or required by regulations and standards, achieve a minimum 1:40 grade to the stack or connection point for sanitary plumbing, or as close as is practicable based on available space constraints.

Discharge from air handling systems

Trays, sumps and plumbing: To HSE ACOP L8.

Thermal movement

General: Arrange piping to accommodate thermal expansion. Provide proprietary expansion joints in copper and plastic pipes where pipe flexibility does not allow for movement. Make sure that movement does not strain branch connections.

Vent pipes

Staying to roof: If fixings for stays penetrate the roof covering, seal the penetrations and make watertight.

Terminations: Provide vent cowls of the same material as the vent pipe.

Maintenance access and openings

Inspection openings and rodding points: As required by the Controlling Authority and in additional locations as documented.

Access openings: Liaise with building trades to provide access openings in the building risers/walls/ceiling. Make sure all inspection openings are accessible.

Vertical stacks: Provide the base of vertical stacks with access openings.

Location: Avoid locating maintenance openings in areas that are unable to be accessed without adverse impact on the critical operations of a facility.

Orientation of access openings: Orientate access openings so that wastewater does not discharge from the opening when opened. Do not orientate access openings so that wastewater flows past above the opening. Make sure coved access opening inserts that align with the geometric form of the pipe are provided to all access openings.

Safe tray protection measures: Where sanitary plumbing is located over critical areas (such as electrical/communications equipment rooms), provide a safe tray. Provide stainless steel safe trays, with discharge to a noticeable location outside the critical area.

3.2 SANITARY DRAINAGE

Laying

General: Lay in straight lines between changes in direction or grade with sockets pointing up hill. If other pipes are adjacent, set each pipe true to line and complete each joint before laying the next pipe. If work is not continuous, cap open ends to prevent entry of foreign matter.

Piping: As documented in the **Sanitary drainage piping schedule**.

Other in ground services: Coordinate and maintain minimum clearances with all other in ground services.

Pipeline identification

General: Lay detectable plastic warning tape, 300 mm above buried piping, for the full length of the piping.

3.3 PIPING

Finishes

General: Finish exposed piping, including fittings and supports, as follows:

- Chrome plate to BS EN ISO 4525 service condition 2, bright in internal locations such as toilet and kitchen areas.

Supports

General: Provide suspension systems capable of supporting piping systems in a flooded state. Provide fixings to connect into structural elements of the suspension system.

Supports: Provide supports spanning structural elements where fixing points at suitable centres cannot otherwise be obtained.

Acoustically treated suspension systems: Where required, provide acoustically treated suspension systems between structural and architectural elements to make sure the requirements of the acoustic report are achieved.

Expansion and contraction

General: Make sure that all components of the piping systems are installed to account for the effects of expansion and contraction without any detriment to the system and without visible distortion.

Pipework movement: Provide mechanisms to allow the pipework movement spanning seismic joints or gaps.

Protection

General: Protect the drainage system from ingress of builder’s debris and the like by temporarily capping open ends and covering inlets during the construction phase.

3.4 VENTING

General

General: Provide venting to assist waste water flows and maintain appropriate system pressure fluctuations.

Atmospheric vents: Provide atmospheric vents for all systems as required by the controlling authority including upstream and downstream vents on drainage systems.

Air admittance valves (AAVs): Use AAVs where specified for branch and fixture vents. Do not use AAVs where atmospheric venting is specified, for vent drainage lines, under bench pump units, pump chambers, chambers/pits, or as terminal vents.

Atmospheric venting: Terminate atmospheric venting in accordance with authority requirements and position clear (at least 12 m where practicable) of spaces that are occupied (including infrequent occupancy), building openings and mechanical air intakes to mitigate odours from impacting on operations.

Termination of vents: Utilise cowls or other approved mechanisms for termination of vents to minimise the entry of vermin and debris to the venting system.

3.5 FLOOR WASTE GULLIES

Plant rooms

Floor waste gullies: Chrome plated brass or stainless steel.

Construction: Suitable for the substrate, water proofing and floor finish.

Grate: Chrome plated brass or stainless steel.

Floor waste gully size: Minimum size 100 mm.

Pressurised rooms: Increase the trap depth by the pressure difference, or double, whichever is the greater.

Priming: Provide electronic trap priming mechanisms to all floor waste gullies in plant rooms.

Rubbish rooms

Floor waste gullies: Stainless steel.

Construction: Suitable for the substrate, water proofing and floor finish.

Floor waste gully size: Minimum size 100 mm.

Grate: Stainless steel and easily removable.

Strainers: Where subject to litter and other debris, double basket strainers. The top strainer basket is to be removable for easy cleaning and the bottom strainer basket is to be permanently fixed to the floor drain.

Residential

Construction: Suitable for the substrate, water proofing and floor finish.

Floor waste gully size: Minimum size 80 mm.

Grate: Chrome plated brass grates or stainless steel.

Shower waste: When floor wastes are installed to act as the primary shower waste, provide a 100 mm grate and gully.

3.6 TENANCY WASTE AND VENT BRANCHES

General

General: Provide tenancy waste and vent branches to tenancies.

Waste branch locations: Two branches - at the lowest level possible above floor level, and at high level. Extend tenancy waste branches to a location that is easily accessible for future fit outs and minimises the abortive work.

Tenancy vent branch locations: As high as practicable above floor level. Terminate vents in a location that minimises abortive work for future fit outs.

Capping and sealing: Cap and seal branches.

3.7 TESTS AND COMMISSIONING

Pre-completion tests

General: Before concealing, carry out the following tests:

- Sanitary plumbing and drainage: Air testing and performance testing
- Outside buildings: To BS EN 752
- Pumped discharge lines: Make sure pump discharge lines are free from leaks when subjected to hydrostatic pressure equal to twice the shut off head of the pump or, if a relief valve is used, twice the pressure at which relief valves operate.

Leaks: If leaks are found, rectify and re-test.

Notification: Provide at least 48 hours notice in writing of the date and time proposed for all testing so that the Engineer, Contractor and/or authorised representative of the Controlling Authority may attend.

Apparatus: Supply all apparatus and materials necessary.

Quality assurance: Provide a Quality Assurance file containing test sheets recording the time and date of all tests carried out and keep on site to make available to the Engineer for review during site visits. Make sure the test sheets are signed by the Contractor responsible for conducting the test. A copy of all Controlling Authority sign-off sheets are also to be kept onsite in the Quality Assurance file.

Air and performance testing

Standard: To BS EN 12056-2 National annex NG.

Camera inspection

General: Upon satisfactory completion of hydrostatic and/or air testing, the Controlling Authority or Engineer may request an internal camera inspection of underground pipe work for visual evidence of straight alignment, flush internal jointing and obstructions.

Rejection: Reject pipework if the pipework does not appear to be aligned, have flush jointing or free of obstructions.

Documentation

General: Provide testing and commissioning sheets and reports for but not limited to the following:

- All pipe work.
- Trade waste treatment systems.

Manufacturer test: Where a specific testing procedure is prescribed by the manufacturer, adhere to this procedure and document testing and commissioning results in the Quality Assurance file.

3.8 COMPLETION

Cleaning

General: On completion clean and flush the whole installation.

4 SELECTIONS

4.1 WASTEWATER

Sanitary plumbing and drainage PVCu/MuPVC piping schedule

Provide PVCu pipe as follows:

- Size range DN 40 to DN 150.
- For branch and float pipework only.
- Manufactured by Polypipe.
- Jointing by solvent welding.

Sanitary plumbing and drainage HDPE piping schedule

Provide HDPE pipe as follows:

- Size range DN 40 to DN 300.
- Manufactured by Geberit.
- Jointing by fusion welding, use fittings or butt joints.

Sanitary plumbing cast iron piping schedule

Provide cast-iron pipe as follows:

- Size range DN 75 to DN 300
- Manufactured by Saint-Gobain Pam Systems (Ensign).
- Jointing by mechanical couplings
- Standard: BS EN 877.

Waterless traps

Manufacturer: HepVo.

Pumped lines piping schedule

Provide polyethylene pipe as follows:

- Size range DN 40 to DN 300.
- Classification: PN16
- Manufactured by Polypipe or Geberit
- Jointing by fusion welding, use couplings.

0823 COLD AND HEATED WATER

1 GENERAL

1.1 RESPONSIBILITIES

General

Requirement: Provide cold water and heated water systems as documented.

Compliance: In accordance with the requirements of the Controlling Authority. Take responsibility, provide written substantiation and obtain approvals for all performance based solutions.

Water source

General: Verify that the intended water source is of a quality, pressure and flow suitable for the intended use via site measurement and sampling.

Mains supply connection

General: Liaise with the network utility operator and provide all necessary documentation to connect to the water main(s).

Timing: Make all arrangements with the network utility operator for the installation to meet the building program.

Liaison: Where the mains connections are a combined domestic/fire services connection, liaise with the fire protection services contractor and ensure pressure sustaining requirements are met.

1.2 CROSS REFERENCES

General

Requirement: Conform to the following worksection(s):

- *0171 General requirements*.
- *0801A Public health systems*.

1.3 STANDARDS

General

Water supply: To BS EN 806.

Heated water supply: To BS EN 806.

Backflow prevention: To BS EN 13077.

Copper pipe: To BS EN 1057

Microbial control: To HSE ACOP L8.

Materials in contact with water:

Valves: To BS 5163 Valves for waterworks purposes.

Authorised products

Standard: Listed in the WRAS (Water Regulations Advisory Scheme) Database, unless otherwise required by the Network Utility Operator.

Installation of glass wool and rock wool insulation

General: Code of practice on safety in the use of synthetic vitreous fibre insultation wools (glass wool, rock wool, slab wool), Geneva, 2000, International Labor Office.

Labelling

Water efficiency labelling: Provide only products conforming to and labelled to the European Water Label Scheme.

1.4 INTERPRETATION

Abbreviations

General: For the purposes of this work section the following abbreviations apply:

- TPR: Temperature and pressure relief.
- COP: Coefficient of performance.
- VSDs: Variable speed drives.

- SDs: Standard deviations.
- DZR: Dezincification.
- FWG: Floor waste gully.
- TMVs: Thermostatic mixing valves.
- GRP: Glass-fibre reinforced plastic.

Definitions

General: For the purposes of this worksection the definitions given below apply.

- Heated water: Water that has been intentionally heated. It includes hot water and warm water.
- FBS-1 (fibre-bio-soluble) mineral wool: Insulation composed of bio-soluble glass or rock fibres.
- Material R-Value: The thermal resistance (m^2.K/W) of a component material R-Value does not include air space or surface resistances.

1.5 SUBMISSIONS

Fire hazard properties

General: Submit evidence of conformance with **MATERIALS**, **Fire hazard properties**.

Samples

General: Submit samples of accessories identified by proprietary item, including the following:

- Valves.
- Instruments, including gauges and thermostats.

Thermal insulation performance

Evidence of suitability: Conformance to BS 5422.

WRAS certification

General: Submit evidence that proposed components are listed in the WRAS (Water Regulations Advisory Scheme) Database.

1.6 INSPECTIONS

Notice

Inspection: Give notice so that inspection may be made of the following:

- Excavated surfaces.
- Concealed or underground services.

2 PRODUCTS

2.1 COMPONENTS

Pressure control valves

General: Provide pressure reducing valves, pressure limiting valves and/or ratio valves which produce the necessary reduction in pressure.

Backflow prevention devices

General: As documented, to the requirements of the Controlling Authority and selected to meet the appropriate hazard level.

Standard: To BS EN 13077

Valves: Provide inline strainers and isolation valves either side of the back flow preventer.

Duplication: Provide two backflow preventers (in parallel) of the same size on all mains water supply connections and in critical situations to permit testing and maintenance without interruption.

Wall cavity locations: Where located within wall cavities, provide recessed stainless steel housing with lockable door and viewing window complete with drain provisions where testable.

Double check valve device: Maintain all units in line and have field replaceable seats, seals, springs and seating disc assemblies.

Reduced pressure zone device: Maintain all units in line and have field replaceable seats, seals, springs and seating disc assemblies.

Seat/seal assemblies: All seat/seal assemblies must have captured springs and body.

Tundish: Provide reduced pressure zone devices with a tundish and drain to a FWG or similar where located internally.

Double check valve assembly: Fit all double check valves with stainless steel replaceable check valve seats.

Check valve assemblies: Removable, modular type that can be disassembled and serviced with threads or fasteners that do not contact water.

Double check valves: Testable insitu.

Line strainers

General: Suitable for the pressure and temperature of the system.

Type: Low resistance, Y-form bronze bodied type, with screen of dezincification resistant brass, corrosion-resistant stainless steel, or monel.

Screen perforations: 0.8 mm maximum.

Size: Line sized.

Strainer size: Provide strainer apertures of a diameter recommended by the manufacturer of the equipment they are serving/protecting.

Pressure drop: Not more than 10 kPa at full flow when clean.

Location: Provide immediately prior to (notwithstanding items with integral built-in strainers) pressure reducing valves, meters, mixing valves and other valves and equipment sensitive to debris.

Construction up to and including 50 mm: Bronze construction with screwed hexagonal ends.

Construction 65 mm and above: Epoxy coated cast iron with full face flanged ends.

Removal: Provide screwed plugs for basket removal for strainers up to 50 mm diameter and a bolted flange fitted with a 20 mm ball valve for strainers larger than 65 mm diameter.

Maintenance: Make sure the design of the strainer provides for even flow through the basket, and the basket section projects well clear of the line of the pipe or the bottom of the flange to allow for servicing without damaging insulation or sheathing.

Pressure gauges

Dial size: 65 mm diameter.

Range and graduations: Scale reading in kPa with a full scale value between 130% and 200% of the working pressure.

Bourdon tube gauges: To BS EN 837-1.

Accuracy grade: Industrial.

Installation: Comply with the recommendations of BS EN 837-1. Isolate from pump pulsations and provide with a gauge cock.

Dial thermometer

Type: Bi-metal type with a multi wound helix direct drive pointer.

Dial size: 65 mm diameter.

Range and graduations: Suitable for the range of temperatures.

Mounting: Vertical or horizontal.

Well: Provide well for gauge removal. Provide pipe enlargement at thermometer well locations in pipes less than 100 mm nominal size to maintain not less than 70% free area of the pipe bore.

Well size: 15 mm nominal size tube of the same material and pressure rating as the pipe, penetrating completely through the pipe.

Well installation: Slope the well and provide a removable cap or plug at the low end to retain oil. Insert a plastic rod into each well to position the thermometer sensing bulb approximately at the centre of the pipe bore.

Water meters - authority

Standard: To be WRAS (Water Regulations Advisory Scheme) approved.

Installation: To the requirements of the Network Utility Operator.

Water meters - check metering

Standard: To be WRAS (Water Regulations Advisory Scheme) approved.

Installation: In readily accessible and readable locations and to the manufacturer’s requirements.

Accuracy: ±2.0% accuracy at design flow, ±5.0% at minimum flow.

Corrosion: Suitable for the installation environment.

Reading panel: Anti-fog type.

Liquid filled registers: Install in the inverted position.

Monitoring systems: Provide electronic output compatible with the monitoring system provided by others. Provide wire connections, radio transmitter or dry contacts as nominated.

Labelling: Label all meters. Permanently label with the name of the area that it serves and documentation that identifies name, serial number, calibration, the installed location, and area served.

Schedule: Provide a schedule identifying calibration, serial number, the installed location and area served.

Design life: 20 years. Use electronic meters in place of mechanical meters where appropriate.

2.2 VALVES

General

General: Suitable for the pressure, temperature and water quality.

General: Of approved manufacture and conform to the requirements of the Controlling Authority and this specification.

Labelling: Label to indicate the service and the fixtures controlled.

Size: Line sized.

Connection up to and including 50 mm: Screw. Provide demountable connection on downstream side.

Connection 65 mm and above: Flange.

Stamp: Stamp with code to identify materials of body, seats, shaft and liners and the figure number of the valve.

Installation: Install according to the particular manufacturer's written recommendations.

Material: Brass or gunmetal components of a type not subject to dezincification (DZR).

Lead: Lead free.

Stems: Seal and adjust valve stems with packed glands.

Location: Install in readily accessible locations for maintenance or adjustment. Locate at low level wherever practicable.

Isolating valves

Type for 15 mm to 50 mm: Ball valve.

Type for 65 mm to 80 mm: Gate valve.

Type for 100 mm to 300 mm: Lugged wafer type butterfly valve.

Isolating regulating valves

Type for 15 mm to 50 mm: Double regulating valve.

Type for 65 mm to 300 mm: Lugged wafer type butterfly valve.

Limit stops: Adjustable limit stops incorporated into flow regulation valves to enable the valve to be reset to the commissioned position after isolation.

Non return/check valves

Type for 15 mm to 50 mm: Swing or horizontal check.

Type for 65 mm to 300 mm: Double flap spring return wafer type.

Pressure regulating valves

Requirement: Provide a pressure regulating valve wherever the supply pressure to any part of the installation may exceed the maximum acceptable delivery pressure for the fixture and fittings served.

Size: Select pressure regulating valves on design flow and operating pressures (this may not necessarily be the pipe size).

Type for up to and including 50 mm: Provide the following:

- Direct acting diaphragm.
- Maximum working pressure of not less than 2100 kPa.
- Adjustable reduced pressure range from 170 to 520 kPa unless noted otherwise.
- Nominal setting of 350 kPa unless specified otherwise.
- Design flow with a maximum drop off pressure of 50 kPa.
- Replaceable seats.
- Replaceable disc without need to dismantle the valve.

Type for 65 mm and above: Provide the following:

- Pilot operated diaphragm with low flow bypass.
- Epoxy coated ductile iron or stainless steel body with stainless steel internal components, nitrile o-ring and gasket.

Ball float valves

General: Of approved manufacture and conform to the requirements of the Controlling Authority and this specification.

Size: Size float valve to supply water at the required flow rate based on the available pressure.

Type for up to and including 40 mm: Direct lever action.

Type for 50 mm and above: Public health servo assisted (pilot operated).

Material for up to and including 65 mm: Bronze.

Material for 80 mm and above: Epoxy-lined cast iron with bronze trim.

Spindles: Non-rising type that do not project into the bore of the valve when the valve is in the fully open position.

Dezincification resistance: Required.

Pressure sustaining valves: Required where full discharge from the float valve would cause the pressure in the supply infrastructure to drop below acceptable levels.

2.3 WATER STORAGE TANKS

General

General: Supply and construct storage tanks, complete with tank foundations, access points, divisions and penetrations for all inlets, outlets, drains, overflows, vents, valves, fittings, and integrate with other systems and associated sensors/equipment.

Cold water storage tanks: To BS EN 806.

Materials: GRP.

Polyethylene water tanks: To BS EN 12573.

Temperature: Do not exceed the rated service temperature of the tank material.

Screened overflow: Provide screen covering to overflow and vent pipes.

Dimensions: Design and construct storage tanks to fit within the space allowed.

Design life: 25 years.

Warranty: 10 years at the completion of installation.

Installation: To the requirements of the Controlling Authority.

Maintenance: Submit complete maintenance schedule and costs from the tank manufacturer to the Principal for approval prior to procurement.

Stagnation: Ensure the tank does not contain regions that could cause water to stagnate e.g. hollow supports.

Structural

General: Designed for the static pressure of water at the highest possible level. Designed for cyclic filling and emptying throughout the design life without fatigue failure.

Foundations and supports: Suitable to support the tank and transfer loads to the underlying structure as required by the structural engineer. To allow minimum 600 mm clearance for below tank inspection where required by the tank design.

Certification: Certified by a registered structural engineer. Provide certification documentation.

Seismic restraints: According the importance level of the building.

Level sensors

General: Install level sensors so they can be easily accessed for maintenance and testing purposes without the need to enter the tank.

Sensor fixings: Provide for fixing of level sensors and associated control systems (for each tank where multiple installations).

Sensor type: Provide level sensors that are the hydrostatic pressure sensing type or approved equal and are capable of detecting levels in minimum 2% volume increments.

Position and install level sensors: Position and install level sensors in a manner that will minimise the impact of turbulent inflows, foreign material and obstructions on accurate level sensing.

Level data: Provide level data using level sensors to enable the control of associated pumping, equipment and alarms.

Level sensor outputs: Integrate level sensor outputs to control systems and panels that directly control related equipment.

Level increments: Present levels in minimum 10% increments between recognised low and high levels.

Connections

General: Provide flanged connections to the tanks. Locate connections for maximum useable tank capacity and easy access for operation and maintenance.

Inlet boxes: Provide inlet boxes for over top filling where specified.

Inflow control: Provide mechanically controlled high-capacity float valve modulating in response to tank level.

Overflow: Provide overflow(s) capable of discharging maximum possible uncontrolled inflow while maintaining sufficient air gap.

Warning overflow: Provide warning overflow(s) to provide visual indication of impending tank overflow. Provide sensor linked to solenoid valve to isolate supply to tank.

Temperature sensor: Provide.

Outlet: Locate to maintain a 50 mm sludge zone.

Sludge/scour drain: Provide 50 mm sludge drain with isolation valve at the base of each tank. Arrange discharge with air gap.

Vortex inhibitor: Provide vortex inhibitor.

Access

Ladders: Provide stainless steel or GRP ladders internally and externally for tanks over 2.0 m high. Incline each ladder at not less than 7.5^{o} from the vertical.

Roof access: Provide minimum 600 mm x 600 mm opening with removal sealed lid.

Sectional panel tanks

General: Form sectional panel tanks from standard sized panels wherever possible that can be moved within the completed facility through doorways and openings. Provide manufacturer designed panels to suit imposed loads and resist deflection.

Panel material: GRP or as scheduled.

Intersecting corners: Seal with special close fitting foam seals.

Internal components: Fabricate internal components in contact with water from 316 stainless steel.

Internal stays: 316 stainless steel. Bolt all tank bracing through the tank panel. Welding of stay rods to brackets is not acceptable.

Internal bolting: 316 stainless steel. Coat threaded connections exposed to water with an approved sealant.

External bolting: 316 stainless steel. Galvanised steel bolts are acceptable for indoor installation where not in contact with water.

External box frame: Provide external box frame where required to accommodate seismic forces.

Connections: Fit all flange connections with high strength nylon insulating bushes. Standard extrusion plastic bushes are not acceptable. Make sure bushes have an integral insulating flange. After installation, check tank and issue a certificate to confirm no leakage exists.

Universal beam supports: Maximum 1000 mm centres and sufficiently level prior to erection. Provide insulating strips under each beam.

2.4 MATERIALS

Fire hazard properties

Spread-of-flame index: Maximum 9 where tested to BS 476.

Smoke-developed index: Maximum 8 if spread-of-flame is over 5, when tested to BS 476.

Flammability index of facing materials: Maximum 5 when tested to ISO 834.2.

Materials with reflective foil facing: Test to BS 476.

2.5 WATER FILTER

General

Purpose: Removal of particles from the incoming water.

Type: Automatic backwashing screen filter.

Filtration level: 50 micron or as scheduled.

2.6 WATER CONDITIONER

General

Purpose: Inhibition of hard scale on drinking water supplies.

- Type: Electromagnetic.
- BMS connection: Required.

2.7 INSULATION MATERIALS

General

Standard: To BS 5422.

Material R-Value of insulation: ≥ Total R-Value in BS 5422 for the type and location of the pipe.

Thermal conductivity: Provide insulation with thermal conductivity not exceeding 0.037 W/mK at a mean temperature of 20 °C.

Stainless steel pipework: Where piping is constructed of stainless steel, provide chloride-free insulation (zero halogen).

Insulating material: Make the insulating material for fittings, valves and flanges of the same type and thickness as for the insulation on the pipe.

Polyolefin foam

Type: Closed cell cross-linked polyolefin foam produced using a hydrocarbon blowing agent.

Insulation surface facing: Heat-bonded aluminium foil laminate.

Glass wool and rock wool and polyester

Description: Select from the following:

- Glass wool or rock wool resin-bonded to form tubular sections.
- Polyester in moulded tubular sections.

Elastomeric foam insulation

Type: Chemically blown closed cell nitrile rubber in tubular sections for pipe insulation, in sheets for insulating pipe fittings, and in sheets or rolls for large pipes, tanks, vessels and heat exchangers.

Physical properties:

- Free of ozone depleting gases in manufacture and composition.
- Moisture absorption: Non-hygroscopic.
- Water vapour permeability: Maximum 0.065 ng/Pa.m.s.

Aluminium foil laminate sheet

Material: Glass fibre reinforced, aluminium foil-paper laminate.

Duty classification: Heavy duty.

Adhesives and sealants

Requirement: Provide adhesives and sealants to manufacturer's recommendations.

Aluminium foil laminate tape

Adhesive: Non-toxic, high tack synthetic pressure sensitive type.

Liner: Silicone coated paper.

Backing: Aluminium foil laminate.

Minimum width: 50 mm.

Minimum mechanical properties: Polyethylene tape to BS EN 60454.

3 EXECUTION

3.1 GENERAL

Electrical installation
See work section *0882A Public health electrical - minor* clause **ELECTRICAL INSTALLATION**.

Motors and drivers
See work section *0882A Public health electrical - minor* clause **MOTORS AND DRIVERS**

3.2 NON-POTABLE (RECYCLED) WATER DISTRIBUTION

General
Identification: Identify non-potable cold water distribution systems from the potable cold water system by separation, labelling and using lilac coloured piping.

3.3 HEATED WATER DISTRIBUTION

Circulation system
Circulation rate: Where heated water systems incorporate circulation measures to maintain the heated water temperature at distance locations, determine the recirculation rate required to maintain field temperature not less than 5 °C below the supply temperature.

Temperature gauges: Provide temperature gauges at each heating system (flow and return) and on every sub circuit (return, adjacent the balancing valve).

Installation: Install hot water and return pipe work in such a manner to avoid isolated high points in the reticulation system that may lead to air locking. Where this is impractical to achieve, provide a facility to bleed air out of this section of pipe work.

Sub-circuits
Sub circuits: Provide sub circuits with proprietary balancing valves to maintain sufficient circulation through each sub circuit.

Delivery waiting time
Heated water delivery times: Make sure heated water delivery times to ablutionary fixtures are less than 20 seconds at the fixture design flow rate and maximum temperature. Locate recirculating water piping to achieve delivery times. Where heated water delivery times cannot be achieved, extend circulation piping or provide alternative temperature maintenance system.

Legionella control
Temperature: Minimise the risk of legionella bacteria growth by making sure temperature maintenance systems maintain supply temperatures at least 60°C or greater.

Treatment system: Where temperatures are lower, provide treatment systems approved by the Engineer.

3.4 PRESSURE REDUCING AND BOOSTING SYSTEMS

Pressure reducing
Water supply pressures: Maintain water supply pressure to fixtures and fittings between 350 kPa (dynamic) and 500 kPa (static), notwithstanding any other pressure requirements for specialist equipment and fittings.

Pressure reducing valves: Provide pressure reducing valves to limit excessive pressure as required. Pressure reducing valves must be adjustable, accurate within 10% and resistant to creep. Pressure limiting valves without adjustment may be used for small (20 mm) branches to equipment only.

Hot water delivery pressures: Provide hot water deliver pressures that are equal (within 50 kPa) to the cold water delivery pressure to mixing devices (tempering valves and taps faucets) notwithstanding any other pressure requirements for specialist equipment and fittings.

Pressure boosting
Pressure boosting systems: Provide pressure boosting systems where the available dynamic pressure will be less than 300 kPa (notwithstanding any other pressure requirements) at the most hydraulically disadvantaged fixture, fitting or appliance under normal building operation.

3.5 PIPING

General
Design life: Select pipe work for a design life of 50 years for the design operating conditions.

Material: As documented in the **Piping system schedule**.

Polypropylene random: Do not use polypropylene random (PP-R) pipework and fittings.

Size

Pipes: Size pipes to limit dynamic pressure loss, so that the system performance, (or individual components), are not adversely affected under full flow conditions.

Pipe diameter: Note pipes with nominal diameter (DN) sizes. Increase in diameter polymeric pipes for water services one size larger that the nominal diameter to ensure the minimum internal diameter is greater than or equal to the nominated size.

Valve sizes: Make sure valve sizes are not smaller than pipework to which they connect. Increase in diameter valves for water services, where constructed from polymeric materials, one size larger that the nominal diameter to ensure the minimum internal diameter is greater than or equal to the nominated size.

Velocities: Size pipes to limit fluid velocities to less than 1.5 m/s within buildings and 2.0 m/s external to buildings. In circulatory domestic hot water systems, limit fluid velocities to 1.2 m/s for the combined flow of probable simultaneous demand and continuous circulation and 0.9 m/s for continuous circulation.

Location

Mains connection: Connect the cold water supplys system to the Network Utility Operator's main through a stop valve and meter.

Cold water system: Provide the cold water supplys system, installed from the meter to the draw-off points or connections to other services as documented in the **Piping system schedule**.

Heated water system: Provide the heated water system, installed from the cold water connection points to the draw-off points as documented in the **Piping system schedule**.

In-ground cold pipework cover: Minimum 900 mm to prevent freezing.

Finishes

General: Finish exposed piping, including fittings, cover plates and supports, as follows:

- Chrome plate copper piping to BS EN ISO 4525 service condition 2, bright in internal locations such as toilet and kitchen areas.
- Paint external above ground piping, and internal steel piping and iron fittings exposed to view.
- In concealed but accessible spaces (including cupboards and non-habitable enclosed spaces): Leave copper and plastic unpainted except for identification marking. Prime steel piping and iron fittings.
- Valves: Finish valves to match connected piping.

Architect’s documentation: Refer to the Architect’s documentation for any special finishes, materials and details.

Fittings and accessories

General: Provide the fittings necessary for the proper functioning of the water supply system, including taps, valves, backflow prevention devices, pressure and temperature control devices, strainers, gauges and automatic controls and alarms.

Provision for dismantling: Arrange piping by the provision of unions or similar so that valves, taps and other maintainable components can be removed for maintenance without disturbing or cutting adjacent piping.

Installation: Install all water reticulation components in accordance with the manufacturer’s recommendations. Submit installation advice contrary to this specification to the Engineer for approval.

Drain cocks: Provide on all low points of pipework.

Material identification marks

General: Pipes with grade or class identification markings: Install so that the markings are visible for inspection.

Pipes under pressure embedded in concrete

General: Do not embed pipework directly in concrete.

Valve spindles

General: If practicable, install valve spindles in a vertical position.

Installation

General: Coordinate pipe work with other services, installed in straight lines and vertically plumb.

Water hammer: Install all components of the systems in a manner to prevent water hammer.

Suspended pipe work: Support suspended pipe work using pipe clamps complete with insertion rubber and threaded rod hangers. Make sure all fixings, brackets and the like are proprietary items of commercial quality.

Expansion and contraction: Install pipe work taking due consideration for expansion and contraction including expansion loops and movable fixings as applicable.

Dissimilar metals: Components manufactured from dissimilar metals are not permitted.

Jointing methods: Use proprietary type jointing of piping systems, installed and tested in accordance with manufacturer's directions.

Isolation

Location: Provide isolation valves as follows:

- To enable the removal of any items of plant, appliances and equipment without the need to drain.
- To enable isolation of toilet amenity areas and modification of the associated circuit without the need to drain the remainder of the circuit.
- To provide sectional isolation of ring mains so the system can be isolated in (minimum 30% zones).

3.6 PIPING INSULATION

General

Requirement – heated water: Insulate all non-chrome plated heated water piping, fittings and valves.

Requirement – cold water: Insulate all non-chrome cold water piping installed in a location likely to allow the formation of condensation, freezing or unintentional heating.

Application: Fit insulation tightly to piping surfaces without gaps. Close butt ends of insulation sections. Minimise number of joints. If the insulation is in half-sections, make only half-circumferential joints at any one place. Seal longitudinal seams in foil laminate and fix insulation at maximum 500 mm centres with polypropylene, zinc-coated steel or aluminium straps.

Before application: Remove scale, rust, grease and the like before application.

Inspection and integrity tests: Do not apply insulation until the pipe has been inspected and pressure/integrity tests have been carried out.

Unions and other items requiring service: Install the insulation so that it is readily removable.

Fittings: Provide insulation with thermal resistance at least equal to that of the adjacent piping insulation.

Finish: Finish all insulation accurately and neatly to present a true and smooth finish.

Insulation material

General: Provide insulation material as documented.

Elastomeric foam insulation

Adhesives: Adhesive fix all longitudinal and butt joints. Adhere to the pipe at end joints, for a distance of 25 mm, to compartmentalise each section. Use only solvent-based adhesive supplied by insulation manufacturer and designed specifically for the material being used.

Sheathing

General: Provide metal sheathing to all piping insulation:

- In plant rooms.
- Where exposed to weather.
- Where exposed to view.
- Where subject to mechanical damage.
- On valves, pipeline components and pumps in sheathed piping.

Metal sheathing: Cover piping with 0.5 mm thick metallic-coated steel sheet sheathing sprung over the insulation in one piece with laps at least 30 mm wide, and fastened with self-tapping screws or snap head rivets at 150 mm maximum centres. Preform the sheathing to match the shape of the insulated pipe and fittings. Position laps to avoid water penetration. In external locations weatherproof the joints and fixings using non-setting mastic.

Alternative protection for elastomeric foam: Where exposed to sunlight but not exposed to mechanical damage, provide 2 coats of tintable, water-based, rubberised, UV resistant, flexible paint finish to outdoor installations.

Surface preparation

General: Clean the surfaces to remove scale, rust, grease and dirt and prepare surfaces to suit the insulation. Restore surface coatings, which have been damaged or affected by welding.

Insulation at pipe supports

General: Provide supports formed to fit around the insulation.

Pipes under DN 28: Either:

- Fit supports directly to pipe and form insulation around the support.
- Support as for pipes DN 28 or over.

Pipes DN 28 or over:

- Replace the insulation at the support point with a shaped timber or cork spacer block. Butt the insulation up to the spacer block and seal with silicone compound. Clad the block and insulation in 0.5 mm metallic-coated steel sheet extending 100 mm both sides of the support.

Insulation of buried pipes

Insulation material: Elastomeric foam certified by the manufacturer as suitable for use direct buried in-ground.

Sealing: Seal all but joints and longitudinal joints and seams with the insulation manufacturer's recommended adhesive. Seal the insulation to the pipe at both ends and each termination.

Valves and fittings: Insulate and seal as for pipe. Install valves in pits.

Protection: Protect the pipe from water penetration. Select from:

- Use of insulation material with integral polymeric coating to protect from mechanical damage, water penetration and the growth of bacteria, mould and mildew.
- Application of high density rubber sheathing supplied by the insulation manufacturer and certified for use underground.

Sleeving: Install the insulated pipe in a PVC-U soil pipe. If the water table may be above the sleeve pipe, seal all joints watertight. If the water table is permanently below the sleeve pipe, provide 10 mm drain holes at 600 mm centres along the bottom centre of the sleeve pipe.

Insulation of piping to solar water heating systems

Standard: BS 5918.

Material: Copper tube to BS EN 1057.

Thickness: Minimum 22 mm.

Insulation material: Insulate flow and return piping between solar collectors and storage vessels as follows:

- Material temperature rating: Minimum 150°C.
- Protection: Protected against ultra violet light mechanical damage, water penetration and the growth of bacteria, mould and mildew.
- Thermal conductivity: Not more than 0.041 W/mK at 23 °C.

Sealing: Seal all but joints and longitudinal joints and seams with the insulation manufacturer's recommended adhesive. Seal the insulation to the pipe at both ends and each termination.

3.7 TRACE HEATING

General

Frost protection: Fit all pipework exposed to external conditions, with electrical trace heating self-regulating temperature maintenance cabling to maintain the water temperature within the pipework.

Power supply: Take the power supply for the cabling from socket outlets within ceiling voids or other nominated locations adjacent to the circulating distribution system.

Heater cable: Apply self-regulating trace heating cable linearly to the hot water service pipe work prior to insulating the system. Power each dead leg from an independent power socket outlet.

Cable length: Make sure the cable length does not exceed the capacity of the supply electrical circuit.

Fixing: Fix the cable to the pipe work using proprietary fixing tape or nylon cable ties every 300 mm or as specified otherwise by the manufacturer. Install cable to the underside where piping is horizontal.

Heater cable: Select heater cable to compensate for the anticipated thermal losses based on the design temperature and exposure to ambient conditions. Where a single cable is unable to compensate for operational heat losses, provide higher performance insulation to those areas.

Alternatively, where insulation improvements are insufficient to compensate heat losses, provide additional cabling or higher output cable.

Pipe work: Attach the trace heating cable to the pipe work as specified and in accordance with the manufacturer's requirements. Make sure the adhesive tape or other approved fixing mechanism is suitable for the piping materials and the adhesive does not degrade or compromise material properties.

Insulation: Make sure pipe insulation is approved for use with heat trace by the insulation manufacturer and is compatible with the heat output of trace heating cable and ambient conditions.

Allowance for heat trace cable: Make allowance for the insulation internal diameter to accommodate the heat trace cable. This is typically one size larger than the pipe nominal bore.

Warning labels: After the application of thermal insulation to the traced dead leg, apply self-adhesive Electric Traced warning labels fixed to the insulation lagging at 3 m intervals and at any access point to the system.

Electrical requirements: Confirm all electrical requirements with the Electrical Services Contractor and provide details on shop drawings.

Electrically protect cable: Make sure that the cable is electrically protected during installation and tested in accordance with the manufacturer's requirements.

Limit cable length: Limit the length of cable runs so that surge currents on start-up at low temperatures do not exceed circuit breaker limitations.

3.8 PITS

General

General: Install below-ground water meters, stop valves and control valves in concrete access pits with removable pit covers.

Construction

Internal dimensions: To give 300 mm clear space all around the fittings in the pit.

Concrete: Grade N20 to BS EN 206, 100 mm thick, reinforced with F82 fabric.

Pit covers: To BS 7903.

Installation

General: Grade floor to a point on one side and drain to the stormwater drainage system. Carry the pit walls up to 50 mm above finished ground level. Cast in the pit cover frame flush with the top. Trowel the top smooth.

3.9 MONITORING DEVICES AND GAUGES

Pressure gauges:

Provide pressure gauges in the following locations:

- Incoming mains water supply.
- Pressure regulation valve outlets.
- Pump inlet and outlets.
- Compound gauges where necessary on pump suctions.

Dial thermometer:

Provide temperature gauges/dial thermometers with isolation cocks as follows:

- Heating water from heating water plant (prior to blending).
- In the distribution system where exiting the heating water plant, on the return system, including at each sub loop return.
- Primary hot water flow and return to calorifiers and the like.

3.10 WATER METERS

Authority metering

General: Liaise with the Network Utility Operator and provide all necessary documentation required to facilitate installation and registration of the meter(s).

Water authority requirements: Make sure locations and enclosures provided meet the Network Utility Operator's requirements.

Installation: Make all arrangements with the Network Utility Operator for the installation to meet the building program.

Monitoring and trending

General: Record data from monitored meters at a minimum of 15 minute intervals and trend to enable identification of unusually high consumption, leaks and any other unusual activity.

Initiate an alarm on the monitoring system when any of the following conditions exist:

- Daily consumption during normal working hours exceeds the normal by 2 standard deviations (SDs).
- Daily consumption out of normal hours exceeds the normal by 1 SD.
- Peak 1 hour demand exceeds the normal by 2 SD's.

Reports: Generate the following reports for any selected period from the collected data:

- Monthly bar chart showing the daily consumption for each day during normal working hours, and outside of normal working hours. Where normal working ours are not quantified, make an agreement with the principal.
- Scatter line chart showing the daily consumption profile for any selected day plotting hourly delivery (m^3/hr) against time (hrs) for a 24 hour period.
- Data spread sheet showing the delivery for each 15 minute interval over a selected 24 hour period.

Additional reporting and alarms: Where applicable provide additional reporting and alarms to satisfy the requirements of building rating and performance measurement tools.

3.11 WATER FILTRATION

General

General: Provide water filtration in the following locations:

- On the incoming mains cold water supplies to commercial block and both residential blocks.
- On rain water supply to package rain water harvesting break tank and booster set.

3.12 WATER CONDITIONING

General

General: Provide water conditioning in the following locations:

- Downstream of each water storage tank and pumpset.
- Downstream of each heated water circulating pumpset.

3.13 TENANT WATER SUPPLIES

General

General: Extend tenant water supplies within the tenant space and terminate with a capped isolation valve. Terminate in an accessible location that does not require abortive works to extend services further within the tenancy (i.e. terminate above tiled ceilings in lieu of hard plaster ceilings).

Valves and fittings: Where not described on drawings, provide isolation valves, pulse water meter, double-check valve, pressure reducing valve and spool piece section on each supply.

Stagnation: Locate spool piece section in supplies to tenant risers. Offline tenant branches remain dry.

3.14 MARKING

Notice plate

General: Provide a notice plate containing condensed emergency instructions, legibly printed or engraved on durable material resistant to defacement, at least 3 mm thick or mounted on board at least 3 mm thick, permanently fixed in a convenient position at the control valves.

3.15 VALVE BOXES

General

General: Provide cast-iron valve boxes with removable covers for access to underground gate valves. Provide cast-iron sluice valve covers for access to sluice valves.

Installation

General: Set beneath each box a shaft formed of PVC-U pipe to give clear access to the valve wheel or spindle. Set top flush with pavement surface, or 15 mm above unpaved surfaces, and encase in formed concrete box 150 mm thick, with top surface trowelled smooth.

3.16 WATER AND LEAK DETECTION

General

General: Provide wet areas with leak detection systems as documented.

Coverage: Provide coverage of the proposed area in a serpentine manner with the system and make sure the presence of water to within 0.5 metres along the length of the system is detectable.

Include the following in the water detection control system/panel:

- Display indicating the distance to the water detection in metres.
- Continuity fault indication.
- Primary fault indication.
- Test function.
- Alarm acknowledge.
- Indicating faults and alarms with an audible and visual alarm at an audible and visible location.
- A voltage free contact output to be energised on alarm for connection to a monitoring system provided by others.
- Fixed cable or tape at 1.5 metre intervals minimum and installed in co-ordination with all other Services Contractors.
- Provide fully dimensioned and coordinated shop drawings of the proposed installation including location of proposed cable or tape, control panel and associated wiring.

3.17 TESTING

General

General: Prior to putting into service any new, repaired, altered or extended existing water installation, test and commission in accordance with the requirements of the Controlling Authority, this specification and any manufacturers requirements.

Testing: Supply all apparatus and materials necessary, and carry out tests as required by this specification, the Controlling Authority and the manufacturer's recommendations in the presence of the Builder and/or authorised representative of the Controlling Authority for the service under test.

Date and time of testing: Provide at least 48 hours' notice in writing of the date and time proposed for all testing so as the Engineer may attend.

Timing of tests: Carry out all tests prior to pipework burial, concealment or being insulated.

Quality assurance: Keep a Quality Assurance file containing test sheets recording the time and date of all tests carried out on site and make available to the Engineer for review during site visits. Make sure the test sheets are signed by the contractor responsible for conducting the test. Keep a copy of all Controlling Authority sign off sheets onsite in the Quality Assurance file.

Manufacturer's testing procedure: Where a specific testing procedure is prescribed by the manufacturer, adhere to this procedure and keep documentation of testing and commissioning results in the Quality Assurance Manual

Pre-completion tests

Pressure tests: Before insulation is applied to joints pressure test piping to BS EN 806.

Leaks: If found, rectify and re-test.

Water supply

Flushing: Prior to carrying out hydrostatic tests all the hot and cold water piping systems, clean and flush to remove foreign matter. Upon completion clean all strainers and aerators. Disconnect equipment including water heating systems during flushing activities.

Pressure tests: pressure test all water piping systems hydrostatically with water at ambient temperature to a pressure of 1.5 times normal working pressure or in accordance with manufacturer's requirements, whichever is greater.

Pressure test duration: Not less than 30 minutes without detectible loss.

Existing systems: Arrange pressure testing so as not to compromise existing systems that may not be capable of supporting the test pressures.

Fittings and appliances: Isolate or disconnect fixtures, appliances and existing systems to prevent damage during testing if necessary.

Cross connections: Isolate systems individually and check for cross connections.

Chlorination: Disinfect the hot and cold water piping system with chlorinated water. Flush all systems with mains water.

Water quality check: Obtain water quality analysis for a representative sample of the building. Test for Pseudomonas, Legionella and Total Viable Count. Provide the report to the Engineer.

Heated water systems

Duration: Operate the heated water system under normal operating conditions for a period not less than 48 hours, and provide steady state temperature throughout. Undertake a visual inspection for leaks within this period.

Capacity: Verify the system recovery capacity by timing the duration to heat the system from ambient to design set point. Initiate a peak probable simultaneous demand event to confirm instantaneous capacity and recovery duration. Record “time to hot” results on defined locations that are agreed to with the Engineer prior to testing, and submit for approval.

Circulation rate: Record the flow and return flow rate (L/s) and temperature (°C) under steady state conditions. Record flow rates for primary individual pump operation.

Heat loss: Quantify heat losses in the heated water distribution system by establishing temperature differentials and recirculation rates and make sure they are not be greater than 25 W per lineal metre of recirculating distribution. Where heat losses exceed this requirement, notify the Engineer for further direction. Ensure temperature differentials in the recirculation system are not greater than design.

Return temperatures: Record the temperature at the end of the hot water flow line in each loop/sub sloop (index points), and verify temperature remains above design set point. Rebalance system if temperatures drop below the minimum design set point.

Balancing valves: Record flows and balancing valve settings through each sub loop under steady state conditions that satisfy design temperature differentials.

Safe trays: Fill all safe trays with water to ensure that they do not leak under full flow conditions.

Relief drains and vents: Test all pressure relief drains, air relief and vent pipes in accordance with manufacturer’s requirements.

Plant: Record and document commissioning results for all items of plant in accordance with manufacturer’s requirements.

Storage tanks

Flush: Clean and flush cold water storage tanks, then re-fill until they overflow. Operate the overflows for a period of not less than one minute.

Overflow: Arrange inflow rates to be equal to the design rate to ensure that overflow provisions are capable of supporting the inflow rate without overfilling storage tanks.

Leaks: Provide tanks that hold water without loss or leakage for a minimum of 5 days at full capacity, then cycle empty and full 3 times with equal holding tests.

Fixtures, fittings and valves

Pressure and flow: Undertake pressure and flow tests and record results for tapware (static and dynamic), for hot and cold services. Carry out tests for ground floor, mid-level and top floor tapware, with exact locations and numbers to be agreed with the Engineer.

Backflow prevention: To BS EN 13077.

Tapware: Check for leaks.

Valves: Check for leaks, including when closed.

3.18 COMPLETION

Commissioning

Strainers: Remove, clean and replace strainer baskets.

Cleaning and disinfection water storage tanks: To BS EN 806.

Cleaning and disinfection water services: To BS EN 806.

Cold water systems: Test and commission to BS EN 806.

Heated water systems: Test and commission to BS EN 806.

Testable backflow prevention devices: Test and commission to BS EN 13077. by a licensed plumber with backflow device accreditation. Tag and certify to the requirements of the network utility operator.

Thermostatic mixing valves: Test and commission to by a licensed plumber with TMV accreditation.

Charging

Completion: On completion of installation, commissioning, testing and disinfection, fill the system with water, turn on control and isolating valves and the energy supply and leave the water supply system in full operational condition. Provide a full operational test to verify conformance.

Maintenance manuals
Standard: To HSE ACOP L8.

Documentation: Provide testing and commissioning sheets and reports for (but not limited to) the following:

. All pipe work.
. Meters – verifying analogue and digital calibration.
. Pressure control valves.
. Thermostatic mixing valves.
. Pressure relief valves.
. Heated water systems.
. Pumps.

3.19 MAINTENANCE

General
Requirement: Conform to the *0891A Public health maintenance* worksection.

4 SELECTIONS

4.1 COLD AND HEATED WATER

Copper piping schedule
Provide copper pipe as follows:
- Size range DN 15 to DN 150.
- Standard: BS EN 1057.
- Manufactured by Yorkshire Copper Tube.
- Jointing by brazing.

Stainless steel piping schedule
Provide stainless steel pipe as follows:
- Size range DN 15 to DN 150.
- Grade: 316L
- Manufactured by Sanha.
- Jointing by orbital welding.

Piping system schedule (in ground)
Provide polyethylene pipe as follows:

Material: PE80.
- Size range DN 15 to DN 150.
- Standard: BS EN 12201.
- Manufactured by Durapipe.
- Jointing by fusion welding using couplings.

Thermal insulation
Provide thermal insulation as follows:
- Material: select from:
  . Closed cell foam
  . Rockwool
- Thickness as follows:
- Manufacturers: Rockwool and Kingspan.

Rockwool			
Pipe size	**Mains and cold water services**		**Hot water services (including open vents)**
	Internal	**External**	
12	30	40	25

15	30	40	25
22	30	40	30
28	30	40	40
35	30	40	40
42	30	40	40
54	25	25	40
67	25	25	50
76	25	25	50
108	20	25	50

Closed cell foam		
Pipe size	**Mains and cold water services and cold feeds**	
	Internal	**External**
12	20	25
15	20	25
22	20	25
28	20	25
35	20	25
42	20	25
54	20	20
67	15	20
76	15	20
108	15	20

. DN15 to DN40 19mm thick
. DN50 to DN100 25mm thick.
. Above DN100 38mm thick.

Valve manufacturers

Approved manufacturers as follows:

Isolation valves:

- Ballofix
- Crane Fluid Systems
- Honeywell
- Pegler Yorkshire

Ball float valves:

- AVK
- Keraflo Aylesbury
- Pegler Yorkshire

Pressure reducing valves:

- Crane Fluid Systems
- Pegler Yorkshire

Surge arrestors:

- Cla-Val Vent-O-Mat RBXb

Non-return valves:

- Crane Fluid Systems
- Pegler Yorkshire

Double check valves:

- Crane Fluid Systems
- Pegler Yorkshire

Pipe interrupter:

- Arrow Valves

- Nabic Valves

Reduced pressure zone devices:

- Arrow valves
- Reliance Water Controls
- Watts Industries

Tap box:

- Arrow valves

Bib taps serving ground floor tree:

- Arrow valves, Model SPTB (to be approved by landscape architect)

Meters:

- Elster
- Itron
- Kamstrup
- Diehl

Urinal flush control valves (PIR sensor and controller):

- Cistermister
- Pegler Yorkshire
- Robert Pearson

Solenoid valves:

- Pegler Yorkshire
- Robert Pearson

Leak detection (Major leak detection for BREEAM Wat 03):

- Robert Pearson
- Aquilar

Leak detection (Automatic movement shut-off for BREEAM Wat 03):

- Robert Pearson (mains electricity with PIR sensor and controller)
- Aquilar (mains electricity with PIR sensor and controller)

Leak detection:

- Andel Floodline
- TTK Liquid Leak Detection Systems

Flow restrictors (combined isolation and flow restrictor):

- Robert Pearson
- Wondervalve

Hot water balancing and regulating valves:

- Crane Fluid Systems
- IMI Hydronics
- Pegler Yorkshire

Models: A listing as an approved manufacturer does not imply that all models from that manufacturer are acceptable.

Water filter schedule

Approved manufacturers:

- Honeywell.
- Hydrotec.

Water conditioner schedule

Approved manufacturer/s:

- Hydrotec.

0824 FUEL GAS

1 GENERAL

1.1 RESPONSIBILITIES

General
General: Provide fuel gas installations, as documented.
Ventilation: Coordinate sufficient ventilation to installation.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following worksection(s):
- *0171 General requirements*.
- *0801A Public health systems*.

1.3 STANDARDS

Reticulated gas systems
General: To IGEM/UP/2.

Gas equipment
Standard: To IGE/UP/10.

Steel mains and services
Maximum operating pressure not more than 1050 kPa: To BS EN 10225.

1.4 SUBMISSIONS

Certificate of appliance approval
General: Submit a certificate stating that the appliance complies with relevant directives.

Exposed piping
General: Submit proposals for location.

Manuals
General: Submit manuals to conforming to **MANUALS**.

Tests
Other tests: Submit results, as follows:
Storage tanks: Submit evidence of production testing to BS 5500.

Calculations
General: Submit pipe sizing calculations confirming calculated pressure drops for the operational system.
Pressure drop: Do not exceed the total pressure drop of 1 mbar from the regulated supply pressure at full flow, and include allowances for control valves, metering and future envisaged gas loads.

Equipment Details
General: Make sure the Contractor submits details of all gas equipment for approval prior to installation. Include but do not restrict to the following:
- Isolation valves.
- Emergency safety valves and systems.

1.5 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Excavated surfaces.
- Concealed or underground services.

2 PRODUCTS

2.1 GAS DETECTION EQUIPMENT

General

Requirement: Supply and install gas detectors sensing the presence of gas in the gas meter room.

Gas type: Suitable for detecting natural gas or LPG as applicable.

Meter: Provide a meter indicating percentage of Lower Explosive Limit.

Indicator lights: Show power on, warning for 20% (adjustable) LEL, alarm for 40% (adjustable) LEL and alarm failure.

Power supply: Suitable for use with a 230 V single phase power supply.

Monitoring system: Provide for connection of external alarm wiring and monitoring system.

2.2 GENERAL ITEMS

Valves

Requirement: Provide valves as required by the Controlling Authority, as documented and as necessary for the safe and proper operation of the system.

Certification: As required by the Controlling Authority.

Size: Line size unless noted otherwise.

Screwed valves: All valves up to and including 50 mm diameter.

Flanged valves: Valves over 50 mm diameter.

Construction: Types and materials suitable for the design pressures and temperatures and service conditions.

Identification: Stamp valves with code to identify materials of body, seats, shaft and liners and the figure number of the valve.

Installation: According to the particular manufacturer's written recommendations.

Dezincification resistant: Brass or gunmetal components not to be subject to dezincification.

Valve stems: Seal and adjust valve stems with packed glands.

Unventilated space: Where valves are located in unventilated spaces, enclosed in a gas tight box within a clearly marked access panel.

3 EXECUTION

3.1 GENERAL

General

General: Perform all work in accordance with the requirements of the Controlling Authority, Network Utility Operator, and gas installation regulations.

Carry out all works: Using suitably qualified and registered persons and all necessary certification is to be provided at commencement and on completion of the works. Provide all isolation, gas detection and safety systems as required by the Controlling Authority.

Installation: Make sure the installation conforms to all hazardous goods regulations.

Uniformity

General: Maintain uniformity of type, class and manufacture of pipe, pipe fittings, valves, joints and connections throughout the whole of each piping installation.

3.2 FUEL GAS SOURCE

General

General: Verify that the gas type, flow, calorific value and pressure is suitable and safe to be used with the appliances and fittings to be installed.

Mains connection and authority meter set installation

General: Provide and install gas supply authority meters as specified.

Liaison: Liaise with the Network Utility Operator and provide all necessary documentation required to facilitate installation of the meter and regulator set and connection to the gas supply infrastructure.

Enclosures: Make sure enclosures provided meet the Network Utility Operator requirements and coordinate with other trades as require making sure ventilation measures are provided.

Responsibility: Take responsibility for making all arrangements with the gas supply authority for the installation to meet the building program and any related costs.

3.3 PIPING

Concealment

General: If practicable, install piping so that it is concealed within service ducts or non-habitable enclosed spaces and does not appear on external walls. Otherwise, provide metal piping mounted on metal brackets and provide metal cover plates at penetrations.

Piping

General: As documented in the **Gas pipeline schedule**.

Pipeline components

Valves: As documented.

Regulators: As documented.

Finishes

General: Finish exposed piping, including fittings and supports, as follows:

- In internal locations such Light Industry Units: Chromed plate copper piping to ISO 4525 service condition 2, bright.
- In concealed but accessible spaces (including cupboards and non-habitable enclosed spaces): Leave plastic unpainted except for identification marking. Paint steel piping and iron fittings 309 Canary Yellow from BS381C

Valves: Finish valves to match connected piping.

Pipework installation

General: Coordinate pipe work with other services, install in straight lines and vertically plumb.

Design life: Select pipe work for a design life of 50 years for the design operating conditions.

Size: Pipes are generally noted with nominal diameter (DN) sizes. Increase the diameter of polymer pipes to provide comparable or lower pressure losses.

Suspended pipe work: Support suspended pipe work using pipe clamps complete with insertion rubber and threaded rod hangers. Provide all fixings, brackets and the like of proprietary items of commercial quality.

Installation: Install pipe work to take in due consideration for expansion and contraction including expansion loops and movable fixings as applicable.

Dissimilar metals: Components manufactured from dissimilar metals are not permitted.

Sheathed pipe: Provide sheathed pipework traversing mechanical ventilation systems or ventilation plant rooms in pipe with outer sheathe venting to atmosphere.

Jointing methods: Provide proprietary type systems to join piping systems and install and test in accordance with manufacturer's directions.

Ventilation

General: Liaise with the relevant parties to make sure that adequate ventilation is provided to the gas installation (natural).

Pipework in unventilated locations: Provide pipe-in-pipe system.

Valves and fittings

General: Provide all valves and fittings as specified and as required to meet the requirements of the controlling authority. Attention is drawn to the following specific requirements:

Provide an automatic gas supply shut off valve initiated by an evacuation fire alarm provided on the main gas supply to the building prior to any take-off where required by the controlling authority.

Purge points: Provide as required

Test points: Provide as required.

3.4 TENANT GAS SUPPLIES

General

General: Extend offline tenant gas supplies to within the tenant’s space.

Location: High level.

Termination: Additional Emergency Control Valve (AECV)

Meter location: Gas meter room.

Authority metered gas supplies: Authority gas meter arranged by future tenant and provided by Gas Utility Operator. .

3.5 MANUALS

General

Requirement: Prepare manuals to include recommendations for the operation, care and maintenance of gas appliances, storage tanks, valves, regulators and their associated fittings.

3.6 COMMISSIONING

General

Provide testing and commissioning sheets for but not limited to the following:

- Pipe work pressure tests.
- Emergency gas shut off systems.
- Fire system gas shut off.

4 SELECTIONS

4.1 FUEL GAS

Piping system schedule

Property			
Material	Black steel medium weight to BS 1387	Black steel medium weight to BS 1387	Copper Tube to BS EN 1057 R250 pipe
Nominal size (mm)	15 - 150	15 - 150	15 - 35
Jointing method	Brazing or approved press-fit	Brazing or approved press-fit	Non-dezincifiable silver brazing to BS EN 1254
Approved manufacturers			Yorkshire Copper Tube

Valves

Approved manufacturers as follows:

Isolation valves:

- DN15 to DN54: Crane Fluid Systems (PN25 BS21 ball valve).
- Above DN54: Crane Fluid Systems (PN16 flanged gate valve).

Emergency gas solenoid:

- DN15 to DN75: Black Teknigas (screwed BS21).
- DN65 to DN250: Black Teknigas (PN16 flanged).

0882A PUBLIC HEALTH ELECTRICAL - MINOR

1 GENERAL

1.1 RESPONSIBILITIES

General

Requirement: Provide public health electrical installations, as documented.

1.2 CROSS REFERENCES

General

Requirement: Conform to the following worksection(s):

- *0171 General requirements*.
- *0801A Public health systems*.

1.3 ELECTRICAL ACCESSORIES

General

Responsibilities: Provide accessories as documented.

Proprietary equipment: If proprietary equipment is selected by the contractor, the requirements of this specification over-ride the specifications inherent in the selections of a particular make and model of accessory.

Uniformity: Provide all accessories and outlets located in close proximity of the same manufacture, size, finish and material.

Default finish: Select from the manufacturers standard range.

2 LOW VOLTAGE POWER SYSTEMS

2.1 GENERAL

General

General: Carry out all work in accordance with the requirements of the controlling authority.

Switchgear, control gear, fittings and accessories: Provide switchgear, control gear, fittings and accessories of uniform type and manufacture throughout the whole of the installation.

Test certificates: Coordinate the work and submit ready for test certificates to the controlling authority in time to allow inspection and tests to be completed for the setting into operation of the systems according to the agreed program.

Coordinate with service Contractors: Arrange the works with the relevant service's Contractors to ensure that all details relative to submain cables, maximum demand, voltage drop, fault levels, earth loop impedance, and discrimination details of switchgear, cable terminations and interfacing of controls have been fully coordinated.

Standards

Electrical systems: To BS 7671.

Selection of cables: To BS 7671.

Degrees of protection (IP code): To BS EN 60529.

Electromagnetic compatibility (EMC): To BS EN 61000.

Telecommunications systems: To BS EN 50174.

2.2 PRODUCTS

Wiring systems

Selection: Provide wiring systems appropriate to the installation conditions and the function of the load.

Power cables

Standard: Polymeric cables to BS 6724.

Cable: Use multi-stranded copper cable generally.

Default insulation: V.75.

Default sheathing: 4V.75.

Minimum size:

- Power sub-circuits: 2.5 mm^2.
- Sub-mains: 6 mm^2.

Earthing

General: All equipment, materials and pipe work is to be earthed where required in accordance with the requirements of the controlling authority and any manufacturer recommendations.

2.3 EXECUTION

Power cables

Straight-through joints: Unless unavoidable due to length or difficult installation conditions, run cables without intermediate straight-through joints.

Individual wiring of extra-low voltage circuits: Tie together at regular intervals.

Tagging: Identify multicore cables and trefoil groups at each end with stamped non-ferrous tags clipped around each cable or trefoil group.

Marking: Identify the origin of all wiring by means of legible indelible marking.

Cable systems: Provide the following:

- Accessible concealed spaces: Thermoplastic insulated and sheathed cables.
- Inaccessible concealed spaces: Cable in PVC-U conduit.
- Plant rooms: Cable in heavy duty PVC-U conduit, or on tray or in duct.
- Plastered or rendered surfaces: Cable in PVC-U conduit.
- Stud walls without bulk insulation: Thermoplastic insulated and sheathed cables.
- Walls filled with bulk thermal insulation: Cables in PVC-U conduit.

Wiring Installation

General: Provide wiring that conforms to the requirements of the controlling authority and is compatible with the equipment and fixtures being served.

Provide the following for all cables:

- Adequately fix and support with purpose made clips, cleats, ties or saddles.
- Install to permit adequate air circulation around each cable.
- Install between equipment without any joints.
- Install on the loop in, loop out principle without the use of connectors for sub circuit wiring.
- Install so that they can readily be withdrawn for the purposes of relocation and/or rewiring.
- Installed so that they are not bent through a radius less than the minimum bending radius recommended by the manufacturer.
- Where installed together, over parallel routes, space apart to provide a gap of one cable diameter, minimum, between adjacent circuit and submain groups.
- Space from communications and other wiring systems in accordance with relevant Standards.
- Segregate from other services to conform to relevant Standards and Authority requirements.
- Carry out all wiring a neat and tidy manner and in accordance with the Wiring Methods Schedule.

3 CABLE SUPPORT AND DUCT SYSTEMS

3.1 GENERAL

Standards

Cable trunking systems: To BS 4678 and BS EN 50085.

Conduits and fittings for electrical installations: To IEC 61386, BS 4607, BS EN 60423, BS EN 61537, BS EN 61386, BS EN 50085 and BS 4565.

3.2 PRODUCTS

Where specifying cable enclosures and routes, take into account the building structure and whether or not they are to be concealed from view.

Non-metallic conduits and fittings

Standards: To BS EN 61386.

Solar radiation protection: Required for conduits and fittings exposed to sunlight.

Flexible conduit: Provide flexible conduit to connect with equipment and plant subjected to vibration. If necessary, provide for adjustment or ease of maintenance. Provide the minimum possible length.

Ducted wiring enclosures

Ducting: Provide purpose-made ducts. Provide rigid supports. Round off sharp edges and provide bushed or proprietary cable entries into metallic ducting.

Accessories: Provide purpose-made accessories and covers to match the duct system. Provide screw-fixed covers or clip-on covers removable only with the use of tools.

Cable support: Except for horizontal runs where the covers are on top, support wiring with retaining clips at intervals of not more than 1000 mm.

Conduits

General: Provide the following for conduits:

- Install using the loop in system.
- Provide free from conduit fittings other than junction boxes, wall boxes, bends or couplings.
- Provide 20 mm minimum diameter. Oval conduits are unacceptable
- Conceal from view by running in concealed voids, wall cavities, ceiling spaces/cavities, concrete slabs, or chased into masonry elements unless otherwise specified or agreed.
- Contain a maximum of two circuits.

Provide with a 3 mm diameter, minimum, and nylon cord for future wiring or wiring for other trades.

Cable trays

General: Provide cable trays incorporating the following details for multiple runs of cable:

- Perforated sheet steel electro zinc plated with 50%, minimum, of its surface area open for air circulation.
- Amend if hot dip galvanised, painted or PVC coated finishes are required.
- Fit with the manufacturer's standard bends, risers, curves, reducers and fishplates.
- Fix to steel brackets and hangers to provide a rigid fixing.
- Fix so that there is sufficient air space between the structure and the tray to which they are secured enabling natural air circulation to occur and for cable access.
- Support so that the maximum deflection between adjacent supports does not exceed 10 mm when fully loaded to the ultimate capacity provided with a 2:1 safety factor.
- Make free from sharp edges or corners.
- Install parallel or at right angles to the building structure and planning grids.
- Size so that they are loaded a maximum 80% of their capacity width, including spaces between cables for derating purposes without undue bunching.
- Provide with sun screens where exposed to sunlight.
- Provide high sided type for cable loads in excess of 20 kg per metre.
- Locate where maintenance access is readily available.

Where provided to support fire rated cable systems, include the following in cable ladders:

- Install to conform to manufacturer’s type test certificates to the relevant Standard.
- Provide similar construction characteristics to that used in the achieved fire rated cable test certificates.

3.3 EXECUTION

Unsheathed cables – installation

General: Provide permanently fixed enclosure systems, assembled before installing wiring. Provide draw wires to pull in conductor groups from outlet to outlet, or provide ducts with removable covers.

Conduit systems – installation

Set out: If exposed to view, install conduits in parallel runs with right angle changes of direction.

Conduits in roof spaces: Locate below roof insulation and sarking. In accessible roof spaces, provide mechanical protection for light-duty conduits.

Expansion: Allow for thermal expansion/contraction of conduits and fittings due to changes in ambient temperature conditions. Provide expansion couplings as required.

4 SWITCHBOARDS

4.1 GENERAL

Standards
Standards: To BS EN 61439.

4.2 PRODUCTS

General
Busbars: Incorporate proprietary busbar systems for the interconnection of isolators, circuit breakers and other circuit protection devices.

Doors: Provide lockable doors with a circuit card holder unless enclosed in cupboards or in an area which is not readily accessible to the public.

IP rating:

- Weatherproof: IP56 minimum.
- Variable speed drives: IP54.
- Otherwise: IP42 minimum.

Separation: Form 1.

Supporting structure: Wall mounted for proprietary switchboards.

Floor mounted: Assemblies over 2 m^2.

Ventilation: Required to maintain design operating temperatures at full load.

Electrical installation
General:

- Provide electrical equipment and installation works that conform to the requirements of the controlling authority.
- Provide switchgear, controls, fittings and accessories of uniform type and manufacture throughout the whole of the installation.
- Coordinate the works with other Contractors as necessary to ensure that all details relative to submain cables, maximum demand, voltage drop, fault levels, earth loop impedance, discrimination details of switchgear, cable terminations and interfacing of controls have been fully coordinated.

Control panels
Where electrical distribution boards or control panels are provided, conform to the following requirements, and include all wiring and equipment required for the complete and proper operation of the systems:

- Provide overall dimensions suitable for the space allocated.
- Design to facilitate easy access to and removal of component parts and to facilitate the undertaking of a thermographic survey of all joints and terminations.
- Make sure there is a degree of protection in accordance with the relevant Standard relative to the installation location, but as a minimum IP43 where installed indoors and IP56 where installed outdoors.
- Do not construct until detailed drawings of each control panel have been approved.
- Use a minimum 1.6 mm thick, sheet metal construction.
- Provide a surface mounted type with only handles, toggles and dials protruding through the front panel.
- Provide adequate space for outgoing wiring, having consideration for the types of cables entering and leaving the assembly.
- Size cable entries and/or gland plates to suit the cables and installation requirements.
- Paint an approved colour with powder coat finish of 0.07 mm thickness or other approved process. Where panels are mounted in a corrosive environment, make sure they are suitably treated and painted.
- Label with 5 mm high black characters on white background for each main control, isolator, time switch, contactor and circuit breaker.
- Provide with a typewritten circuit schedule, pump specification controls description in a clear acrylic holder mounted inside the door.

- Incorporate alarms, alarm mute switch and indicating and warning lights in panels.
- Include the following in panel mounted indicator lights:
- Ultra bright light emitting diode (LED) type with a minimum design life of 50,000 hours.
- Fresnel patterned coloured lenses of 19 mm diameter minimum for indication.
- Replaceable from the front without having to remove the lamp holder assembly.
- Fit installations having in excess of 3 indicator lamps on the one switchboard with a push to test button to verify the operation of the lamps powered from a common voltage supply.
- Provide panels complete with circuit breakers, programmable logic controllers, thermal overloads and starters, necessary for the operation of the equipment.
- Provide selector switches, 3 position automatic, manual and off type, and label accordingly for the testing and operation of components of the system.
- Provide suitable access and terminal connections for any control or interfacing systems provided by others.
- Symmetrically mount equipment on the control panels and make sure all drillings are neatly and accurately made. Carry out all internal switch board wiring in a neat and tidy manner.
- Provide doors with a heavy duty tumbler type lock complete with two keys per cabinet that are common to all switchboard locks installed. Adopt a standard lock coding. Provide alternative keying where approved by the principal.
- Provide doors with compressible neoprene gaskets contained within a metal channel and have chromium plated lift off pintle type hinges. On completion, thoroughly clean all control panel interiors and exteriors free from debris, grit, marks and dirt.

5 SWITCHBOARD COMPONENTS

5.1 PRODUCTS

General

Rated duty: Uninterrupted in non-ventilated enclosure.

Rated making capacity (peak): Minimum 2.1 x fault level (r.m.s.) at assembly incoming terminals.

Utilisation category: To BS EN 60947.

Circuits consisting of motors or other highly inductive loads: At least AC-23.

Coordination: Select and adjust protective devices to discriminate under over-current and earth faults.

Switch-isolator units

Standard: To BS EN 60947-1 and BS EN 60947-3.

Moulded case and miniature circuit breakers

Moulded case breakers: To BS EN 60947-1 and BS EN 60947-2.

Miniature circuit breakers: To IEC 60898.

Operation: Independent manual operation including positive ON/OFF indicator.

Trip type: Conform to the following:

- Moulded case breakers: Required.

Miniature circuit breakers: Fixed thermal, fixed magnetic.

Isolation facility: Required.

Current limiting: Conform to the following:

- Moulded case breakers: Required.

Utilisation category: Moulded case breakers:

- Final subcircuit category: Category A.
- Mains and submains: Category B.

Trip settings: Set as documented, seal, and label.

Trip units: Connect interchangeable and integrally fused trip units so that trip units are not live when circuit breaker contacts are open.

Fuses with enclosed fuse links

Standards: To BS 88 and BS EN 60269.

Fuses with fuse-links for the protection of semiconductor devices: To BS 88 and BS EN 60269.

Fuses with fuse-links used as fault current limiters: Coordinate fuse type and rating with the protection switchgear manufacturer's recommendation where used downstream of the fault current limiters. Provide labels adjacent to the fuse holder stating FAULT CURRENT LIMITER and fuse size.

Fuse links: Enclosed, high rupturing capacity type mounted in a fuse carrier.

Breaking range and utilisation category:

- Distribution/general purpose: gG.
- Motors: gM.

Fuse-holders: Mount fuse-holders so that fuse carriers may be withdrawn directly towards the operator and away from live parts. Provide fixed insulation which shrouds live metal when the fuse carrier is withdrawn.

Barriers: Provide barriers on both sides of each fuse link, preventing inadvertent electrical contact between phases by the insertion of screwdriver.

Spare fuse links: Provide 3 spare fuse links for each rating of fuse link on each assembly. Mount spares on clips within the spares cabinet.

Busbar mounted fuse holders: Provide fuse carriers with retaining clips, minimum fuse holder 32 A.

Contactors

Standard: To BS EN 60947.

Type: Enclosed, block type, air break, electro-magnetic.

Poles: 3.

Rated operational current: The greater of:

- Full load current of the load controlled.
- 16 A.

Auxiliary contacts: Provide auxiliary contacts with at least one normally-open and one normally-closed separate contacts with rating of 6 A at 230 V a.c., utilisation category: AC-1.

Control devices and switching elements

Standards: To BS EN 60947.

Rotary switches: operated type with switch positions arranged with displacement of 60º.

Off position: Locate at the 12 o'clock position. Test positions must spring return to off position.

Control relays standard: To BS EN 60947.

Indicator lights

Standard: To IEC 73.

5.2 EXECUTION

Marking and labelling

General: Provide labels including control and circuit equipment ratings, functional units, notices for operational and maintenance personnel, incoming and outgoing circuit rating, sizes and origin of supply and kW ratings of motor starters.

6 MOTORS AND STARTERS

6.1 GENERAL

General: Provide motors selected in conformance BS EN 60034-1, the application load characteristics, motor manufacturers' recommendations and the following:

- Motors 0.75 kW and over: Three phase.

Rating

Standard: To BS EN 60034-1.

Maximum power rating: The greater of the documented minimum motor size and next preferred standard frame size above the maximum load of the driven equipment.

Duty: Minimum S1.

Class: Continuous running.

Speed: Maximum 1500 r/min.

Starting performance

Designation: To BS EN 60034-1.

Speed and torque: To suit the driven equipment. Make sure each motor develops torque relative to the starting load of the driven machine such that it runs up to full speed steadily and within a time period compatible with motor winding temperatures, class of insulation and rating of the starting equipment.

Efficiency

Motors documented as high efficiency: To BS EN 60034-31.

All other motors: To BS EN 60034-1.

Environment

Site operating conditions: To BS EN 60034-1.

Electrical operating conditions: To BS EN 60034-1.

Enclosure

General: Provide enclosures appropriate to the environment in which the motor operates.

Motor enclosure classification: Minimum IP44 to IEC 60034-5.

Cooling

Standard: To BS EN 60034-6.

Classification: Minimum IC01.

Marking

Terminals: To BS EN 60034-8.

Mounting

Standard: International mounting (IM) classification to BS EN 60034-7.

Noise

Standard: To BS EN 60034-9.

Vibration

Standard: To ISO 10816 and ISO 2372.

Grade: Minimum N (normal).

6.2 STARTERS

Standard

General: To IEC 60947.

Electromechanical motor starters: To IEC 60947.

Selection

General: Provide motor starters selected according to the following:

- Electricity distribution network limitations for starting currents and voltage flicker.
- Torque requirements for the motor load.
- Heating effects on the motor.
- Voltage drop during start due to starting currents.
- Time required to accelerate from rest to full speed.
- Number of starts per hour.

Motor capacity: Select motors of sufficient capacity so that they cannot be overloaded under any normal operating conditions.

Performance

Rated operational current: At least the full load current of the load controlled.

Rated duty: Intermittent class 12.

Utilisation category: AC-3.

Mechanical durability: Minimum 3 million cycles to IEC 60947.

Electric durability: Minimum 1 million operations at AC-3 to IEC 60947.

Mounting: Mount with sufficient clearance to allow full access for maintenance, removal and replacement of coils and contacts, without the need to disconnect wiring or remove other equipment.

Auxiliary contacts: Provide separate auxiliary contacts with at least one normally-open and one normally-closed contacts with rating of 6 A at 230 V a.c., utilisation category: AC-1.

Slave relay: If the number of auxiliary contacts exceeds the number which can be accommodated, provide separate slave relays.

Direct-on-line starters
Type: Direct-switching electromagnetic contactor.

6.3 MOTOR PROTECTION

General
General: Provide over-current protection with manual reset giving overload protection in each phase of supply as part of the equipment assembly for each motor starter.

Standard: To IEC 60947.

Contacts: Provide at least one normally-open and one normally-closed set of contacts rated at the starter control circuit voltage and minimum 4 A. Connect contacts to open the starter at the setting temperature.

- Utilisation category: AC-11.

Mounting: Ensure relays are not affected by the shock of mechanical contactor operation. Provide sufficient clear space for the disconnection, removal and replacement of heaters, without disconnecting other equipment and wiring.

Protection Features
Select and adjust motor protection to provide

- Thermal overload protection.
- Dry running protection.
- Under voltage/over voltage protection.
- Short circuit and earth leakage protection.
- Overload protection at 110% of nominal current.

Single phase motor protection
General: Provide overload units matching the motor heating curve characteristics.

3-phase motor protection
General: Provide thermal overload protection relays for each motor.

Provide the following:

- Triple pole relays with differential trip bar operation for single phase protection, and ambient temperature compensation.
- Thermal overloads connected directly to contactor by means of proprietary links, except where operated separately by current transformers.

Current transformers: Saturating at 10 to 15 times full load current, Class 10P.

Variable Speed Drives
Variable speed drives: Where variable speed drives are specified, provide with harmonic filters to mitigate harmonic interference with the electrical distribution system.

Dynamic speed reduction to avoid overload condition.

VOL 3: Schedules

VOL 3: Schedules

0800S EQUIPMENT SCHEDULES

1 OIL BYPASS SEPARATOR

Item No	**OBS-C-0B-01(*1,2,3)**
Location	Commercial block basement Pump room
Description	Oil Class 1 Bypass Separator
Quantity	1
Inlet Pipe Diameter (mm)	315
Outlet Pipe Diameter (mm)	315
Pipe Flow (L/s)	11

Item Notes:

1. Unit to be supported approximately 1.5 m above floor level.
2. Provide access gantry for maintenance.
3. Unit selection based on Kingspan NSBP006.

2 ULTRA VIOLET SCHEDULE

Item No	**UV-A-B-01(*1,2,3)**	**UV-C-B-01(*1,2,3)**	**UV-C-B-02(*2,3)**	**UV-M-B-01(*1,2,3)**
Location	Affordable block basement Water plantroom	Commercial block basement Water plantroom	Commercial block basement Rain water plantroom	Marketable block basement Water plantroom
Description	Ultraviolet water disinfection unit, located on the BCWS directly after the EMWC-A-B-01	Ultraviolet water disinfection unit, located on the BCWS directly after the EMWC-C-B-01	Ultraviolet water disinfection unit, located on water supply from rain water harvesting tank	Ultraviolet water disinfection unit, located on the BCWS directly after the EMWC-M-B-01
Quantity	1	1	1	1
Minimum UV Dose(µWs/cm²)	36000	36000	36000	36000
Design Flow Rate(L/s)	5.2	8.2	1	6.6

Item Notes:

1. UV unit shall have WRAS approval.
2. UV unit to be provided with temperature sensor and dump valve.
3. Provide controller with volt-free contacts for connection to BMS including light intensity monitoring.

3 ELECTROMAGNETIC WATER CONDITIONER SCHEDULE

Item No	Location	Description	Peak Flow(L/s)
EMWC-A-B-01(*1,2)	Affordable block basement Water plantroom	In Line Electromagnetic Water Conditioner on the BCWS directly after the booster pumpset	5.2
EMWC-C-06-01(*1,2)	Commercial block 6th floor Mechanical plantroom	In Line Electromagnetic Water Conditioner on the HWR directly after the circulation pumpset	0.5
EMWC-C-B-01(*1,2)	Commercial block basement Water plantroom	In Line Electromagnetic Water Conditioner on the BCWS directly after the booster pumpset	8.2
EMWC-M-B-01(*1,2)	Marketable block basement Water plantroom	In Line Electromagnetic Water Conditioner on the BCWS directly after the booster pumpset	6.6

Item Notes:

1. Provide BMS capable controller.
2. Equipment to have WRAS approval.

4 FILTERS SCHEDULE

Item No	**WF-A-0B-01(*1,2,3)**	**WF-C-0B-01(*1,2,3)**	**WF-C-0B-02(*3)**
Location	Affordable block basement Water plantroom	Commercial block basement Water plantroom	Commercial block basement Rain water plantroom
Description	Inline particle filter with automatic backwash	Inline particle filter with automatic backwash	Rain water harvesting filtration train
Quantity	1	1	1
Filter Type	Element/particle filter with automatic backwash facility	Element/particle filter with automatic backwash facility	Element/particle filters with automatic backwash facility
Filtration Level (micron)	50	50	5
Minimum Operating Inlet Pressure (kPa)	500	500	500
Design Flow Rate (L/s)	1.2	6.1	1

Item No	**WF-M-0B-01(*1,2,3)**
Location	Marketable block basement Water plantroom
Description	Inline particle filter with automatic backwash
Quantity	1
Filter Type	Element/particle filter with automatic backwash facility
Filtration Level (micron)	50
Minimum Operating Inlet Pressure (kPa)	500
Design Flow Rate (L/s)	1.2

Item Notes:

1. Unit to have WRAS Approval.
2. Provide differential pressure switch and timer for backwash.
3. Monitoring / controls shall be provided by the mechanical contractor's controls specialist in accordance with the mechanical specification.

5 STORAGE TANK SCHEDULE

Item No	**CAT 5-A-B-01(*1,2)**	**CAT 5-C-B-01(*1,2)**	**CAT 5-M-B-01(*1,2)**
Location	Affordable block basement Water Plantroom	Commercial block basement Water Plantroom	Marketable block basement Water Plantroom
Description	Packaged Category 5 water break tank and booster set	Packaged Category 5 water break tank and booster set	Packaged Category 5 water break tank and booster set
Minimum Effective Capacity (L)	60	60	60
Dimensions (mm)	600 x 1100 x 1100	600 x 1100 x 1100	600 x 1100 x 1100
Type/Construction	Packaged system	Packaged system	Packaged system

Item No	**CWST-A-0B-01(*3,4,5,2,6)**	**CWST-C-0B-01(*3,4,5,2)**	**CWST-M-0B-01(*3,4,5,2,6)**
Location	Affordable block basement Water Plantroom	Commercial block basement Water Plantroom	Marketable block basement Water Plantroom
Description	Combined domestic cold water storage tank and fire sprinkler tank	Domestic cold water storage tank	Combined domestic cold water storage tank and fire sprinkler tank
Minimum Effective Capacity (L)	3000	29 500	5000
Dimensions (mm)	2500 x 2000 x 1000	4000 x 3000 x 3000	2500 x 2500 x 1000
Type/Construction	GRP externally flanged with externally flanged base sectional tank with encapsulated HCFC and CFC free 40 mm insulation. Provide AISI 316 stainless steel fixings throughout complete with AB air gap. Provide concrete plinth to manufacturer's requirements.	GRP externally flanged with externally flanged base sectional tank with encapsulated HCFC and CFC free 40 mm insulation. Provide AISI 316 stainless steel fixings throughout complete with AB air gap. Provide concrete plinth to manufacturer's requirements.	GRP externally flanged with externally flanged base sectional tank with encapsulated HCFC and CFC free 40 mm insulation. Provide AISI 316 stainless steel fixings throughout complete with AB air gap. Provide concrete plinth to manufacturer's requirements.

Item No	**RWAT-C-0B-01(*7,8,9)**	**RWAT-C-0B-02(*8)**	**RWHT-C-0B-01(*10)**
Location	Commercial block basement Rain water plantroom	Commercial block basement Rain water plantroom	Commercial block basement Rain water plantroom
Description	Rain water attenuation tank with integrated rain water harvesting tank	Rain water attenuation tank.	Packaged rain water harvesting break tank and booster set
Minimum Effective Capacity (L)	169 000	180 000	60
Dimensions (mm)	17000 x 4500 x 2500	16000 x 5000 x 2500	600 x 650 x 2100
Type/Construction	GRP internally flanged.	GRP internally flanged.	Packaged system

Item Notes:

1. Provide complete, package system including integral break tank, twin solenoid controlled inlets, high level control float switch, category 5 air gap.
2. Unit and fittings to be WRAS approved.
3. Provide two compartments for maintenance.
4. Provide high and low-level level sensors in each compartment. Provide temperature sensor in each compartment. Levels and temperature to be monitored by BMS.
5. Provide to each compartment: - Heavy duty bolted down cover - Vent cowls - Ball valve connection - Screened overflow - Screened warning pipe - High water alarm electrode - 28 mm nominal diameter drain - Cold water connection - Low water pump cut out/alarm electrode - Raised ball valve housing with side access manway - Temperature sensor pocket (free issue from controls specialist) - Internal GRP ladders - External galvanised steel ladders
6. The storage volume includes 2 m3 water volume serving sprinkler system. Refer to fire documentation for details.
7. Tank to be provided with internal separation and internal overflow to create integrated volume for the rain water harvesting system . Rain water harvesting compartment to be 1.5 m (L) x 5 m (W) x 2.5 m (H) Volume allocated to rain water harvesting effective storage volume to be min 12 000 L.
8. Provide concrete plinth to manufacturer's requirements.
9. Tank to be provided with the rain water flow restrictor RWFR-C-0B-01 to limit discharge flow rate.
10. Provide complete system package system including integrated break tank, electronic water level control integrated with solenoid valve.

6 FLOW CONTROL VALVES SCHEDULE

Item No	**FR-0B-01**(*1,2,3,4)
Location	Commercial block basement Low level of rain water attenuation tank RWAT-C-0B-01
Description	Rain water flow control valve
Discharge Flow Rate(L/s)	5.9

Item Notes:

1. Provide top access for access to emergency drain down release cable.
2. Unit to be grade 304 stainless steel.
3. Unit to be Aquality or approved equal vortex flow control valve.
4. Unit to be capable of 25 kPa head.

7 PUMP SCHEDULE

Item No	**CAT5-A-B-01**(*1,2,3,4,5)	**CAT5-C-B-01**(*1,2,3,4,5)	**CAT5-M-B-01**(*1,2,3,4,5)
Location	Affordable block basement Water plantroom	Commercial block basement Water plantroom	Marketable block basement Water plantroom
Description	Packaged category 5 water break tank and booster set	Packaged category 5 water break tank and booster set	Packaged category 5 water break tank and booster set
Type	Multi-stage Centrifugal	Multi-stage Centrifugal	Multi-stage Centrifugal
Quantity	1 set (duty/standby)	1 set (duty/standby)	1 set (duty/standby)
Flow (L/s)	1	4	1
Operating Head (kPa)	550	800	500
Speed Control	Variable	Variable	Variable
Electrical Power (kW)	1 kW per pump	5.5 kW per pump	1 kW per pump
Power Supply (V/Ph/Hz)	400/3/50	400/3/50	400/3/50
Water Temperature (°C)	10	10	10
Pump Line Material	Copper Tube	Copper Tube	Copper Tube

Item No	**CWPP-A-0B-01**(*1,2,3,6,7)	**CWPP-C-0B-01**(*1,2,3,6,7)	**CWPP-M-0B-01**(*1,2,3,6,7)
Location	Affordable block basement Water plantroom	Commercial block basement Water plantroom	Marketable block basement Water plantroom
Description	Combined domestic cold water and sprinkler system booster pump set	Domestic cold water booster pump set	Combined domestic cold water and sprinkler system booster pump set
Type	Multi-stage Centrifugal	Multi-stage Centrifugal	Multi-stage Centrifugal
Quantity	1 set (duty/ assist / standby)	1 set (duty/ assist / standby)	1 set (duty/ assist / standby)
Flow (L/s)	8	8.2	9.5
Operating Head (kPa)	550	650	500
Speed Control	Variable	Variable	Variable
Electrical Power (kW)	4 kW per pump	5 kW per pump	4 kW per pump
Power Supply (V/Ph/Hz)	400/3/50	400/3/50	400/3/50
Water Temperature (°C)	10	10	10
Pump Line Material	Stainless Steel 316	Stainless Steel 316	Stainless Steel 316

Item No	**RWHP-C-0B-01(*2,3,4)**	**RWHT-C-0B-02(*8,2,3,4,5)**
Location	Commercial block basement Water plantroom	Commercial block basement Water plantroom
Description	Rain water harvesting pump	Packaged rain water harvesting control unit with integrated break tank and booster set
Type	Multi-stage Centrifugal	Multi-stage Centrifugal
Quantity	2 set (duty/standby)	1 set (duty/standby)
Flow (L/s)	1	1
Operating Head (kPa)	250	300
Speed Control	Variable	Variable
Electrical Power (kW)	0.5 kW per pump	0.5 kW per pump
Power Supply (V/Ph/Hz)	230/1/50	400/3/50
Water Temperature (°C)	10	10
Pump Line Material	Copper Tube	Copper Tube

Item Notes:

1. Pumpset and fittings to be WRAS approved.
2. Provide volt-free contacts for connection to BMS.
3. Monitoring controls to be provided by the mechanical contractor.
4. Provide isolation valves, non-return valves and pressure gauges.
5. Provide 12 L accumulator.
6. Provide isolation valves, non-return valves and temperature and pressure gauges.
7. Provide 200 L full flow-through accumulator.
8. Provide complete system including integrated touch screen for indication of operation status, system pressure, water level, pumps settings and detailed failure indication

8 CIRCULATION PUMP SCHEDULE

Item No	**HWCP-C-06-1**(*1,2,3,4,5)
Location	Commercial block 6th floor Mechanical plantroom
Description	Domestic hot water circulation pump
Pump Type	In-line
Quantity	2
Flow (L/s)	0.5
Operating Head (kPa)	50
Speed Control	Variable (3 speed selection)
Power Supply (V/Ph/Hz)	230/1/50
Water Temperature (°C)	65
Pump Line Material	Copper Tube

Item Notes:

1. Circulation pumpset to be automatically alternating duty/standby. Pump speed to be controlled by return temperature.
2. Pumpset and fittings to have WRAS Approval.
3. Provide volt-free contacts for connection to BMS.
4. Monitoring controls to be provided by the mechanical contractor.
5. Provide isolation valves, non-return valves and temperature and pressure gauges.

9 HEATED WATER SYSTEM SCHEDULE

Item No	**DHW-C-07-1(*1,2,3,4)**
Location	Commercial bloc 7th floor Hot water plantroom / roof
Description	Domestic hot water storage calorifiers heated by air source heat pumps
Quantity	1
Recovery Rate (L/hr)	1031
Storage Volume (L)	4x1000
Temperature Setting (°C)	60
Primary Heat Source Type	Electric heat pumps
Primary Heat Source Required (kW)	2x30 kW
Power Supply (V/ Ph/ Hz)	400/3/50

Item Notes:

1. Mitsubishi Heavy Industries Q-ton air source heat pump package or equal and approved.
2. Provide complete package including 4 no 1000 L domestic hot water cylinders, 2 air-source heat pumps, hot water temperature sensor, remote controller, remote monitoring system, SIM card and router.
3. Provide volt-free contacts for connection to BMS.
4. Equipment to have WRAS approval.

10 TRACE HEATING SCHEDULE

Item No	**TH-A-06-01(*1,2)**	**TH-A-06-02(*1,2)**	**TH-A-0G-01(*1,2)**
Location	CAT 5 pipework exposed to external conditions In plant area	CAT 5 pipework exposed to external conditions In plant area	Cat 5 pipework serving bin store
Description	Frost protection trace heating tape	Frost protection trace heating tape	Frost protection trace heating tape
Temperature Setting (°C)	4	4	4
Power Supply (V/Ph/Hz)	230/1/50	230/1/50	230/1/50

Item No	**TH-A-0G-02(*1,2)**	**TH-C-04-03(*1,2)**	**TH-C-04-04(*1,2)**
Location	Cat 5 pipework serving cycle store	CAT 5 pipework exposed to external conditionon on west terrace	CAT 5 pipework exposed to external condition on east terrace
Description	Frost protection trace heating tape	Frost protection trace heating tape	Frost protection trace heating tape
Temperature Setting (°C)	4	4	4
Power Supply (V/Ph/Hz)	230/1/50	230/1/50	230/1/50

Item No	**TH-C-04-CAT5.LL(*1,2,3)**	**TH-C-05-03(*1,2)**	**TH-C-05-04(*1,2)**
Location	CAT 5 pipework exposed to external conditions running at low level	CAT 5 pipework exposed to external condition on north terrace	CAT 5 pipework exposed to external condition on south terrace
Description	Frost protection trace heating tape	Frost protection trace heating tape	Frost protection trace heating tape
Temperature Setting (°C)	4	4	4
Power Supply (V/Ph/Hz)	230/1/50	230/1/50	230/1/50

Item No	**TH-C-05-CAT5.HL(*1,2,4)**	**TH-C-05-CAT5.LL(*1,2,3)**	**TH-C-06-CAT5.LL(*1,2,4)**
Location	CAT 5 pipework exposed to external conditions running at high level	CAT 5 pipework exposed to external conditions running at high level	CAT 5 pipework exposed to external conditions running at low level
Description	Frost protection trace heating tape	Frost protection trace heating tape	Frost protection trace heating tape
Temperature Setting (°C)	4	4	4
Power Supply (V/Ph/Hz)	230/1/50	230/1/50	230/1/50

Item No	**TH-C-07-BCWS(*1,2)**	**TH-C-07-DHW(*1,2)**	**TH-C-07-HWF(*1,2)**
Location	Boosted cold water system pipework serving DHW plantroom exposed to external conditions	Water pipework serving DHW plantroom exposed to external conditions	Hot water flow pipework extended from DHW plantroom exposed to external conditions
Description	Frost protection trace heating tape	Frost protection trace heating tape	Frost protection trace heating tape
Temperature Setting (°C)	4	4	4
Power Supply (V/Ph/Hz)	230/1/50	230/1/50	230/1/50

Item No	**TH-C-07-HWR(*1,2)**	**TH-C-0G-01(*1,2)**	**TH-M-06-01(*1,2)**
Location	Hot water return pipework extended to DHW plantroom exposed to external conditions	Bin store	CAT 5 pipework exposed to external conditions In plant area
Description	Frost protection trace heating tape	Frost protection trace heating tape	Frost protection trace heating tape
Temperature Setting (°C)	4	4	4
Power Supply (V/Ph/Hz)	230/1/50	230/1/50	230/1/50

Item No	**TH-M-06-02(*1,2)**	**TH-M-0G-01(*1,2)**	**TH-M-0G-02(*1,2)**
Location	CAT 5 pipework exposed to external conditions In plant area	Cat 5 pipework serving bin store	Cat 5 pipework serving cycle store
Description	Frost protection trace heating tape	Frost protection trace heating tape	Frost protection trace heating tape
Temperature Setting (°C)	4	4	4
Power Supply (V/Ph/Hz)	230/1/50	230/1/50	230/1/50

Item Notes:

1. Trace heating pipework shall be provided with identification labels reading “Caution Electrical Trace Heating
2. Monitoring controls and BMS connection shall be provided by the mechanical contractor’s controls specialist in accordance with the mechanical specification.
3. 4 no pipes
4. 2 no pipes

11 WATER METER SCHEDULE

Item No	**WM-A(*1)**	**WM-A-0B-01(*2)**	**WM-A-0B-02(*2)**	**WM-A-0B-03(*3,4,5,6)**
Location	Affordable block	Public footpath in Georgiana Street	Affordable block Basement	Affordable block Basement
Room	Public health riser		Cold water plantroom	Cold water plantroom
Description	Utility water meter serving individual flat	Utility non-revenue water meter on incoming mains on incoming mains serving Affordable Block	Utility water meter on mains connection to water category 5 system	Proprietary leak/ escape of water detection meter installed on the mains water supply, linked to shut-off valve assembly
Water Flow Rate (L/s)	0.6	1.2	1	1.2
DN Size (mm)	22	35	28	35
Type	Metering	Metering	Metering	Metering

Item No	**WM-A-0B-04(*3,4,6)**	**WM-A-0B-05(*3,4,6)**	**WM-C-06(*2,4,7,8,6)**	**WM-C-0B-01(*2)**
Location	Affordable block Basement	Affordable block Basement	Commercial block 6th floor	Public footpath in Royal College Street
Room	Cold water plantroom	Cold water plantroom	Hot Water Plantroom	
Description	Proprietary leak/ escape of water detection meter installed between CWST and booster set, linked to shut-off valve assembly	Proprietary leak/ escape of water detection meter installed on the mains CAT5 supply, linked to shut-off valve assembly	Landlord's check water meter on BCWS serving DHW plantroom	Utility Water Meter on incoming mains to water plantroom serving Commercial Block
Water Flow Rate (L/s)	5.2	1	3	6.1
DN Size (mm)	76	35	54	67
Type	Metering	Metering	Metering	Metering

Item No	**WM-C-0B-02**(*2,4,7,9,6)	**WM-C-0B-03**(*2,4,7,8,6)	**WM-C-0B-04**(*2,4,7,8,6)	**WM-C-0B-05**(*2)
Location	Commercial block basement	Commercial block basement	Commercial block basement	Public footpath in Royal College Street
Room	Commercial Block water plantroom, as close as possible to where mains supply enters the plantroom	Cold Water Plantroom	AHU plantroom	
Description	Landlord's Leak Detection check meter serving Commercial Block	Landlord's check meter on BCWS serving Commercial Block CAT5 system	Landlord's check meter on BCWS serving shower area in Commercial Block	Utility non-revenue water meter on incoming mains to fire sprinkler tank serving Commercial Block
Water Flow Rate (L/s)	6.1	4	3	1.7
DN Size (mm)	76	67	42	42
Type	Metering	Metering	Metering	Metering

Item No	**WM-C-0B-06**(*2,4,10,6)	**WM-C-0B-07**(*2,4,7,8,6)	**WM-C-0B-08**(*2,4,6)	**WM-C-0B-09**(*2,4,6)
Location	Commercial block	Commercial block basement	Commercial block basement	Commercial block basement
Room	Commercial Block fire plantroom, as close as possible to where mains supply enters the plantroom	Rain water plantroom	Commercial Block water plantroom	Commercial Block water plantroom
Description	Landlord's Leak Detection check meter serving Commercial Block Fire Plantroom	Landlord's check meter on CAT5 supply to rain water harvesting system	Proprietary leak/ escape of water detection water meter installed on the mains water supply linked to shut-off valve assembly	Proprietary leak/ escape of water detection water meter installed on before CWPP-C-0B-01, linked to shut-off valve assembly
Water Flow Rate (L/s)	1.7	1	6.1	8.2
DN Size (mm)	42	35	76	108
Type	Metering	Metering	Metering	Metering

Item No	**WM-C-0B-10(*2,4,6)**	**WM-C-0B-11(*2,4,6)**	**WM-C-0B-12(*2,4,6)**	**WM-C-0B-13(*2,4,6)**
Location	Commercial block basement	Commercial block basement	Commercial block basement	Commercial block basement
Room	Commercial Block water plantroom	Commercial Block water plantroom	Commercial Block water plantroom	Commercial Block water plantroom
Description	Proprietary leak/ escape of water detection meter installed on main BCWS Tenants' supply, linked to shut-off valve assembly	Proprietary leak/ escape of water detection meter installed on main BCWS Landlord's supply, linked to shut-off valve assembly	Proprietary leak/ escape of water detection meter installed on BCWS supply to DHW system, linked to shut-off valve assembly	Proprietary leak/ escape of water detection meter installed on main CAT 5 supply, linked to shut-off valve assembly
Water Flow Rate (L/s)	3.2	7.7	3	4
DN Size (mm)	67	67	54	67
Type	Metering	Metering	Metering	Metering

Item No	**WM-C-LL(*11,4,7,8,6)**	**WM-C-T1(*12,4,7,8,6)**	**WM-C-T2(*13,4,7,14,6)**	**WM-IU1-01(*2)**
Location	Commercial block offices toilets on each floor	Commercial block Tenant Units	Commercial block Tenant Units	Public footpath in Pratt Street
Room	Public health riser	Tenants' riser	Tenants' riser	
Description	Landlord's check water meter on boosted cold water system supply serving toilet areas	Landlord's check meter	Landlord's check meter on water category 5 connection to the terrace irrigation systems.	Utility water meter on incoming mains serving Light Industry Unit 01
Water Flow Rate (L/s)	0.6	0.44	0.7	0.8
DN Size (mm)	28	22	28	28
Type	Metering	Metering	Metering	Metering

Item No	**WM-IU1-02(*2,4,6)**	**WM-IU2-01(*2)**	**WM-IU2-02(*2,4,6)**	**WM-IU3-01(*2)**
Location	Industry Unit 1	Public footpath in St Pancras Way	Industry Unit 2	Public footpath in St Pancras Way
Room	as close as possible to where mains supply enters the unit		as close as possible to where mains supply enters the unit	
Description	Proprietary leak/ escape of water detection meter installed on the mains water supply, linked to shut-off valve assembly	Utility water meter on incoming mains serving Light Industry Unit 02	Proprietary leak/ escape of water detection meter installed on the mains water supply, linked to shut-off valve assembly	Utility water meter on incoming mains serving Light Industry Unit 03
Water Flow Rate (L/s)	0.8	0.8	0.8	0.8
DN Size (mm)	28	28	28	28
Type	Metering	Metering	Metering	Metering

Item No	**WM-IU3-02(*2,4,6)**	**WM-IU4-01(*2)**	**WM-IU4-02(*2,4,6)**	**WM-IU5-01(*2)**
Location	Industry Unit 3	Public footpath in St Pancras Way	Industry Unit 4	Public footpath in St Pancras Way
Room	as close as possible to where mains supply enters the unit		as close as possible to where mains supply enters the unit	
Description	Proprietary leak/ escape of water detection meter installed on the mains water supply, linked to shut-off valve assembly	Utility water meter on incoming mains serving Light Industry Unit 04	Proprietary leak/ escape of water detection meter installed on the mains water supply, linked to shut-off valve assembly	Utility water meter on incoming mains serving Light Industry Unit 05
Water Flow Rate (L/s)	0.8	0.8	0.8	0.8
DN Size (mm)	28	28	28	28
Type	Metering	Metering	Metering	Metering

Item No	**WM-IU5-02(*2,4,6)**	**WM-M(*15)**	**WM-M-0B-01(*2)**	**WM-M-0B-02(*2,4,6)**
Location	Industry Unit 5	Marketable block	Public footpath in Georgiana Street	Marketable block Basement
Room	as close as possible to where mains supply enters the unit	Public health riser		Cold water plantroom
Description	Proprietary leak/ escape of water detection meter installed on the mains water supply, linked to shut-off valve assembly	Utility water meter serving individual flat	Utility non-revenue water meter on incoming mains serving Marketable Block	Utility water meter on mains connection to water category 5 system
Water Flow Rate (L/s)	0.8	0.6	1.2	1
DN Size (mm)	28	22	35	28
Type	Metering	Metering	Metering	Metering

Item No	**WM-M-0B-03**(*3,4,5,6)	**WM-M-0B-04**(*3)	**WM-M-0B-05**(*3,4,6)	**WM-RU1 (Café)-01**(*2)
Location	Marketable block Basement	Marketable block Basement	Marketable block Basement	Public footpath in Pratt Street
Room	Cold water plantroom	Cold water plantroom	Cold water plantroom	
Description	Proprietary leak/ escape of water detection meter installed on the mains water supply, linked to shut-off valve assembly	Proprietary leak/ escape of water detection meter installed between CWST and booster set, linked to shut-off valve assembly	Proprietary leak/ escape of water detection meter installed on the mains CAT5 supply, linked to shut-off valve assembly	Utility water meter on incoming mains serving Retail Unit 1 (Caffe)
Water Flow Rate (L/s)	1.2	6.7	1	0.6
DN Size (mm)	35	76	35	28
Type	Metering	Metering	Metering	Metering

Item No	**WM-RU1 (Café)-02**(*2,4,6)	**WM-RU1-01**(*2)	**WM-RU1-02**(*2,4,6)
Location	Retail Unit 1(Cafe)	Public footpath in Georgiana Street	Retail Unit 1
Room	as close as possible to where mains supply enters the unit		as close as possible to where mains supply enters the unit
Description	Proprietary leak/ escape of water detection meter installed on the mains water supply, linked to shut-off valve assembly	Utility water meter on incoming mains serving Retail Unit 01	Proprietary leak/ escape of water detection meter installed on the mains water supply, linked to shut-off valve assembly
Water Flow Rate (L/s)	0.6	0.5	0.5
DN Size (mm)	28	22	22
Type	Metering	Metering	Metering

Item Notes:

1. 14 No Meters
2. 1 No Meter
3. 1 No Meter
4. Equipment to have WRAS approval.
5. Disable the meter and shut-off valve prior to sprinkler system commissioning.
6. Connect meter to BMS.
7. The water meter will have a pulsed or other open protocol communication output to enable connection to an appropriate utility monitoring and management system, e.g. a building management system (BMS), for the monitoring of water consumption.
8. Water meter to meet BREEAM WAT 2 credit requirements
9. Water meter to meet BREEAM WAT 3 and WAT 2 credit requirements
10. Water meter to meet BREEAM WAT 3 credit requirements
11. 13 No Meters
12. 21 No Meters

13. 4 No Meters
14. Water meter to meet BREEAM WAT 2 credit requirements
15. 19 No Meters

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