CARNELL WARREN ASSOCIATES

PERFORMANCE SPECIFICATION FOR BUILDING SERVICES INSTALLATIONS

The Almonry, Battle

Client

Battle Town Council

CWA Author

WH

Date

17/12/2019

Revision

CONTENTS

SECTION A DESCRIPTION OF THE WORKS

A.1 GENERAL
- A.1.1 Scope and Interpretation
- A.1.2 Discrepancies

A.2 THE PARTIES

A.3 THE BUILDING
- A.3.1 Location, Address and Name of the Building(s) where the Works are to be undertaken
- A.3.2 Brief Description of Existing, Retained and Proposed Building(s)
- A.3.3 Occupation (if any) of the Building(s) where the Works are to be undertaken
- A.3.4 Summary of the Main Contract
- A.3.5 Summary of the Building Services Installation
- A.3.6 Anticipated Main Contract Program (For Information Only)

A.4 SCOPE OF THE WORKS
- A.4.1 Design Responsibility
- A.4.2 The Contract
- A.4.3 The Installation
- A.4.4 Program & Phasing of the Works
- A.4.5 Design Warranty
- A.4.6 Defects Liability Period

A.5 SUMMARY OF ELECTRICAL SERVICES WORKS INCLUDED IN THIS CONTRACT

A.6 SUMMARY OF MECHANICAL SERVICES WORKS INCLUDED IN THIS CONTRACT

A.7 SUMMARY OF PUBLIC HEALTH SERVICES WORKS INCLUDED IN THIS CONTRACT

A.8 SUMMARY OF WORKS EXCLUDED FROM THIS SUB-CONTRACT

A.1 GENERAL

A.1.1 Scope and Interpretation

The complete Specification, appendices thereto, and the accompanying design drawings, when read together, set out the complete contract requirement with regard to the Services Installation.

This section of the Specification describes the Description of Works relating to the Services Installation and is the Particular Specification relevant to this Contract.

The design drawings and Specification shall form a single entity, be complementary to each other and all items shown or described in either or both shall be provided within the tender sum.

Where a requirement stated in Section A is in direct and irreconcilable contradiction to a specification requirement set out elsewhere in this Specification, the stated requirement of Section A shall prevail subject always to the provisions of Clause A.1.2.

Section A is common to both Electrical and Mechanical Services Installations. Where Section A applies to a Sub-Contract comprising Electrical and Mechanical Services Works all clauses shall be adhered to. Where the Sub-Contract comprises either Mechanical Services Works or Electrical Services Works, any reference to materials and/or workmanship of elements of the installation that are obviously outside of the scope of this particular Installation, shall be disregarded.

The term “Contractor” shall mean the Main Contractor which shall include the Services Contractor. The term “Main Contractor” shall mean specifically the Main Contractor.

Words in the singular shall include the plural meaning and words in the plural shall include the singular meaning.

The use of any specific gender term shall mean all genders.

Headings shall be regarded as for reference only and shall not affect the meaning or interpretation of text.

Reference to any Act, Regulation, Code of Practice or Statutory Code shall be interpreted to include any change, re-enactment, or extension of the Act, Regulation, Code of Practice or Statutory Code.

The term “persons” shall include natural persons, firms, partnerships, companies, corporations, associations, and organisations and all these terms shall be interchangeable.

A.1.2 Discrepancies

The Tenderer shall give written notice to the Services Consultant prior to the submission of his tender to advise of any apparent discrepancy between or within this Specification and the Tender Drawings. The Services Consultant shall instruct the Tenderer as to the correct interpretation of the documents and the Tenderer shall ensure his Tender submission is in accordance with such instructions.

Should the Tenderer fail to notify the Services Consultant of such a discrepancy prior to the submission of the tender, then there shall be no claim on the Employer for any cost and/or program implications arising out of a clarification made by the Services Consultant subsequent to placing the order with the Contractor.

A.2 THE PARTIES

Employer:	Battle Town Council
Architect:	John D Clarke Architects
Quantity Surveyor:	Blade Consulting
CDM Coordinator:	John D Clarke Architects
The Principal Designer:	John D Clarke Architects
The Principal Contractor:	TBC
Services Consultant:	Carnell Warren Associates Ltd, Duke House, Duke Street, Woking, GU21 5BA

A.3 THE BUILDING

A.3.1 Location, Address and Name of the Building(s) where the Works are to be undertaken:

The Almonry, Battle.

A.3.2 Brief Description of Existing, Retained and Proposed Building(s):

A Grade II listed property used as a public space, offices and Battle Town Council Offices. The property is to be refurbished including new services throughout.

A.3.3 Occupation (if any) of the Building(s) where the Works are to be undertaken:

The Building will be vacant for the duration of the build.

A.3.4 Summary of the Main Contract:

Refer to main contract details.

A.3.5 Summary of the Building Services Installation:

Installation of new M&E services. new boiler plant, heating pipework, controls, radiators, lighting, small power, fire alarm, hearing loop, ventilation.

The Building Services Installation shall be a single Contract/Sub-Contract comprising Mechanical Services, Electrical Services and Public Health Services Installations.

A.3.6 Anticipated Main Contract Program

See Main Contract documents for details

A.4 SCOPE OF THE WORKS

A.4.1 Design Responsibility

A.4.1.1 Performance Specification

The construction of project shall be undertaken on a “Design & Build” basis and this Specification and associated Drawings provide a Performance Specification. The Contractor shall be responsible for the detailed design of the mechanical and electrical services installations, which shall be developed and executed in accordance with this Performance Specification.

A.4.2 The Contract

The Services Contract/Sub-Contract shall be a Domestic Sub-Contractor to the Main Contractor.

A.4.3 The Installation

The Contract is for the complete installation, testing and commissioning and setting to work of the mechanical, electrical and public health services as specified herein.

A.4.4 Program & Phasing of the Works

The Work shall be undertaken in a single phase with one Practical Completion for the complete installation in accordance with the agreed programme.

A.4.5 Design Warranty

The Contractor is required to provide a Design Warranty in favour of the Employer. The Form of Warranty shall be as stated elsewhere.

A.4.6 Defects Liability Period

This shall be as stated in the Main Contract Documents. Unless otherwise stated the Contractor shall allow for a Defects Liability Period of 12 Months to run from the date of the Practical Completion Certificate.

A.5 SUMMARY OF ELECTRICAL SERVICES WORKS INCLUDED IN THIS CONTRACT

A.5.1 Design

A.5.1.1 Detailed Design by Contractor

A.5.2 Survey

A.5.2.1 Topographical and Subterranean Scan of Construction Zone

N/A

A.5.2.2 Survey of Existing Services

N/A

A.5.3 Incoming Services

A.5.3.1 Electricity

Existing Head end to be retained.

A.5.3.2 Telephone

2 pair lines shall be brought in for each of the office space and 4 pair for the town council.

A.5.3.3 Cable TV

N/A

A.5.3.4 Data/Fibre Optic Services

Cable ducts to be provided for future installation of service

A.5.3.5 Alarm Interface Services

A panic alarm shall be provided with dial out function. The panic alarm shall be located in the reception desk.

A.5.4 Stripping Out

All electrical services are to be stripped out except the data services within the office spaces at first floor. This includes the SWA cable running on the outside of the property to the museum which is redundant.

A.5.5 Temporary Connections

N/A

A.5.6 Electrical Sub-Stations

Not required

A.5.7 Low Voltage Electrical Mains

From the existing head end and meter the tails shall be taken into a fused disconnector locally where a SWA cable shall then be run to the main distribution panel. Panels shall be as Eaton Memshield.

Unless stated to the contrary mains services shall be run in 500v volt rated PVC insulated cables in conduit or trunking containment. Cables shall be LSZH (LS0H) specification which shall apply to sheathing and insulation materials.

A.5.8 Sub-Mains Services and Distribution

From the main panel individual circuits shall be taken to each of the office spaces. These shall be metered at the main panel.

Install all distribution and sub-distribution panels and connect circuits as required from panels to serve all power, lighting and small power services as indicated on the drawings.

Unless stated to the contrary sub-mains services shall be run in 500v rated XLPE-SWA cables. Cables shall be LSZH (LS0H) specification which shall apply to sheathing and insulation materials.

A.5.9 External Services

Install services from distribution panels to run and connect to serve existing external lighting.

Unless stated to the contrary external services shall be run in 500v rated XLPE-SWA cables.

A.5.10 Electrical Power and Small Power

Install power supplies from distribution panels to serve mechanical services, ventilation equipment and plant equipment terminating with isolators adjacent to equipment served as indicated on the drawings.

Install dedicated final circuits from the main distribution panel to serve panic alarm. Install final radial and ring main circuits small power circuits from distribution panels to run and connect to socket outlets, fused connection units and isolators etc all as indicated on the drawings. All services to be recessed/flushed in.

Individual separate circuits shall be run to each of the office spaces and shall be metered at the panel.

Sockets within AV plant, Mechanical plant or within joinery shall be in white plastic.

A provisional sum should be allowed for the decorative sockets elsewhere.

Circuits shall be run within the floor void through existing notches, in trays within the lower ground floor where possible and within the loft space in trays.

Unless stated to the contrary final circuits shall be run in 500v rated pvc insulated twin and earth cables. Cables shall be LSZH (LS0H) specification which shall apply to sheathing and insulation materials.

A.5.11 Lighting Services

The property shall have a traditional lighting system. The office space light fixtures shall be retained but the wiring shall be renewed.

Within the town council areas all new lighting is to be provided.

Install final circuits from distribution panels to serve switched. Where indicated provide lighting switching by PIR, time switching, and dawn/dusk switching.

Where indicated provide circuits for operation of local fans to operate in conjunction with lighting switching.

Circuits shall be run within the floor void through existing notches, in trays within the lower ground floor where possible and within the loft space in trays.

Supply and install luminaires as detailed on the drawings/Install luminaires provided by the contractor.

Unless stated to the contrary final circuits shall be run in 500v rated pvc insulated twin and earth cables. Cables shall be LSZH (LS0H) specification which shall apply to sheathing and insulation materials.

A.5.12 Emergency Escape Lighting Services

Emergency lighting shall be provided to all means of escape. This shall be provided by a battery system with inverter. The cables shall be MICC firetuff and run to all the lighting within the means of escape.

Installation shall be to BS 5266.

All emergency escape and signage luminaires shall be of the self-test type except where specifically stated to the contrary and except in the case of dwelling houses. Cables shall be LSZH (LS0H) specification which shall apply to sheathing and insulation materials.

A.5.13 Fire Detection and Alarm Services

A complete automatic fire detection and alarm system to Category L1 for Commercial Application shall be provided. A dedicated electrical supply to the system shall be taken directly from the Main Distribution Panel and the circuit shall be clearly marked “Fire Alarm - Do Not Disconnect” at the panel.

Installation shall be to BS 5839. Cables shall be LSZH (LS0H) specification which shall apply to sheathing and insulation.

Cabling shall be run in MICC Firetuff cabling.

A.5.14 Intruder Detection, Alarm and Monitoring Services and CCTV Surveillance Services

A panic alarm with dial out function shall be provided as per drawings.

Cables shall be LSZH (LS0H) specification which shall apply to sheathing and insulation materials.
The installation includes the cable services only and excludes hardware unless otherwise stated.

A.5.15 Telephone/Data/Internet Installation Services

Installation as per drawings. Within the office spaces there shall be a BT line provided, the internal fit out will be via the tenant or retained as existing.

A.5.16 Entertainment/Television Installation Services

N/A

A.5.17 Audio/Public Address/Sound Reinforcement Installation Services

A hearing loop will be installed throughout the ground floor

A.5.18 Access Control/Door Entry Systems

A BPT video door entry system with fob access shall be provided with a single receiver on the reception desk.

Cables shall be LSZH (LS0H) specification which shall apply to sheathing and insulation materials.

A.5.19 Lightning Protection System

Not Applicable

A.5.20 Electrical Services Associated with Mechanical Services Installations

The Contractor shall include for the following, which shall be priced under Electrical Services Installations:
All 230/400V mains wiring required between electrical distribution panels and local isolators/fused connection units to be provided adjacent to Controls Panels and items of Mechanical Services Plant/Equipment as specified.

NOTE - Where local ventilation fans are specified as being wired off the local lighting circuit, all wiring associated with this shall be undertaken as part of the Electrical Installation.

A.5.21 Access and Facilities for the Disabled People – Part M Building Regulations

Not Applicable

A.5.22 Builderswork Associated with the Electrical Services Installations

In addition to all other specified requirements, the Contractor shall include for forming all necessary chases in structure for installation of conduit, forming pockets in structure for installation of recessed accessories and for forming holes in structure up to 100mm x 100mm for passage of services and for fire stopping all such holes.

A.5.23 Testing Commissioning, and Documentation

Testing Commissioning, and Documentation shall be provided as detailed elsewhere in this Specification.

A.5.24 Record Drawings and Operation & Maintenance Manuals

Record Drawings and Operation & Maintenance Manuals shall be detailed elsewhere in this Specification.

A.5.25 Conservation of Fuel & Power

The Contractor shall include for the requirements of Section B of this Specification.

A.5.26 Planned Preventative Maintenance

The Contractor is to include the maintenance of the complete electrical services installations from the time of Practical Completion until the end of the 12 months Warranty Period detailed in Section I of the Specification.

A.6 SUMMARY OF MECHANICAL SERVICES WORKS INCLUDED IN THIS CONTRACT

A.6.1 Design

A.6.1.1 Detailed Design by Contractor

A.6.2 Survey

A.6.2.1 Topographical and Subterranean Scan of Construction Zone

Not Applicable.

A.6.2.2 Survey of Existing Services

Not Applicable.

A.6.3 Incoming Services

A.6.3.1 Gas

The existing gas meter is to be relocated as per the drawings. The contractor shall apply and procure Cadent to have the meter relocated as per drawings.

A.6.3.2 Water

Contractor to place order with Water Supply Company to provide new 32mm MDPE mains water supply.

A.6.3.2 Fuel Oil

Not Applicable

A.6.4 Stripping Out

Not required

A.6.5 Temporary Connections

Existing mains water can be retained for building purposes if required. But will be billed to the main contractor

A.6.6 External Services

Install external gas and water services to the boiler plant. The water service shall be provided with drain down point for winter operation.

External pipework shall be insulated and wrapped in PIB.

A.6.7 Gas Services

Extend gas services from meter position and run and connect to the gas fired boiler.

Provide gas stop valves adjacent to all items served.

The gas services shall be run in trac pipe. The runs shall be continuous with no joints.

A.6.8 Fuel Oil services

Not applicable

A.6.9 Central Plant Installations

Two gas fired condensing boiler shall be provided as per drawings. These shall be provided with heating pumps and low loss header to feed the radiators throughout the property.

A mikrofill pressurization unit shall be installed.

A.6.10 Space Heating Installations

Space heating shall be by a LPHW radiators. The radiators shall be provided with a lock shield valve and a 230 volt actuator which will switch via a heatmiser neo thermostat located in each area and wall mounted.

The radiators shall be fed from the gas fired boilers with LPHW at 80/60.

The heating system shall be unvented. All pipework shall be insulated, labelled copper tube.

A.6.11 Domestic Cold Water Services Installations

Install services in accordance with Section D of this Specification.

From the incoming mains extend a cold feed to the point of use electric hot water generators and also extend cold water services to run and connect to all sanitary appliances and kitchen equipment as appropriate.

Provide a cold water make up to the central heating system.

All pipework shall be insulated and labelled copper tube.

A.6.12 Domestic Hot Water Services Installation

Domestic hot water services are to be provided by point of use hot water generators as per drawings. Where units complete with storage are specified an appropriate expansion vessel shall be provided.

All pipework shall be insulated copper tube.

A.6.13 Irrigation Services

N/A

A.6.14 Comfort Cooling & Air Conditioning Services

N/A

A.6.15 Mechanical Ventilation Services Installations

The installation shall be in accordance with Part F of the Building Regulations. Mechanical extract ventilation shall be provided to serve all bathrooms, shower rooms, the kitchen and the utility room by means of local extractor units all as indicated on the drawings. All other areas of the building shall be ventilated by natural means.

Mechanical ventilation with heat recovery shall be provided to ventilate the basement ceiling void and space generally. The MVHR unit shall be placed within the boiler room and the supply duct shall extend into the ceiling void below. The air shall naturally (via the ceiling void) route through to the opposite end where an intumescent grille shall allow the supply air into the room. Extract back to the unit shall be provided at the opposite end to the intumescent grille as per drawings.

Ductwork shall run as per drawings. Where they connect to outside the final 2 m leg shall be insulated.

A.6.17 Thermal Insulation

Contractor to provide thermal insulation as Section F of this Specification.

A.6.18 Noise Level Survey and Acoustic Treatment

A.6.18.1 Noise Level Survey

N/A

A.6.18.2 Acoustic Treatment

Acoustic treatment is required job-side of the in-line fans.

Contractor shall engage specialist to provide acoustic treatment as detailed elsewhere in this Specification and as required to comply with the Criteria as set down in Section C of the Specification.

A.6.19 Electrical Services Associated with Mechanical Services Installations

Provide electrical installation as described elsewhere in this Specification. See Section A.5.20 for work included within the Electrical Section.

A.6.20 Automatic Control and Building Management Systems

Not Applicable – Heatmiser Neo shall be provided throughout.

A.6.21 Access and Facilities for the Disabled People – Part M Building Regulations

Not Applicable

A.6.22 Builderswork Associated with the Mechanical Services Installations

In addition to all other specified requirements, the Contractor shall include for forming all necessary holes in structure up to 100mm x 100mm for passage of services and for fire stopping all such holes.

A.6.23 Testing Commissioning, and Documentation

Testing Commissioning, and Documentation shall be provided as detailed elsewhere in this Specification.

A.6.24 Record Drawings and Operation & Maintenance Manuals

Record Drawings and Operation & Maintenance Manuals shall be provided as detailed elsewhere in this Specification.

A.6.25 Conservation of Fuel & Power

The Contractor shall include for the requirements of Section B of this Specification.

A.6.26 Planned Preventative Maintenance

The Contractor is to include the maintenance of the complete mechanical services installations from the time of Practical Completion until the end of the 12 months Warranty Period as described in Section G of this Specification.

A.7 SUMMARY OF PUBLIC HEALTH SERVICES WORKS INCLUDED IN THIS CONTRACT

A.7.1 Design

A.7.1.1 Detailed Design by Contractor

A.7.2 Survey Existing Drainage System

A.7.2.1 Topographical and Subterranean Scan of Construction Zone

Contractor shall undertake survey as detailed in Section G of this Specification

A.7.2.2 Survey of Existing Services

Contractor shall undertake survey as detailed in Section G of this Specification.

To ensure connections into the mains sewer are adequate or need repair/replacing

A.7.3 Local Authority Connections

A.7.3.1 Foul

Existing connection should be retained and made good where needed.

A.7.3.2 Rainwater

Existing connection should be retained and made good where needed.

A.7.4 Stripping Out

The external gulley shall be removed and relocated as per drawings.

A.7.5 Temporary Connections

May be required during construction for site welfare

A.7.6 In-Ground Drainage Services

Provide drainage services within the internal lightwell as per drawings. The existing manhlole cover shall be replaced with a double sealed access cover.

A.7.7 Drainage Pumping Equipment

Not Applicable

A.7.8 Above Ground Soil and Waste Water Sanitation Services

The installation shall be in accordance with Part H of the Building Regulations. The system shall comprise plastic drainage internally and heritage cast externally.
Stacks shall be vented wherever possible. The use of AAVs (Durgo valves) will only be accepted if prior approval is given.

A.7.9 Sanitary Ware

Sanitary ware shall be as specified by the Architect and as Supplied Free Issue by the Main Contractor. The Services Contractor shall install the sanitary ware to the setting out dimensions provided by the Architect.

A.7.10 Rainwater Collection & Disposal Services

Rain water guttering and roof outlets shall be as detailed by the Architect. The Contractor shall install vertical internal and external rain water pipes and connect to roof gullies and gutter outlets as necessary. Internal stacks shall be plastic, external stacks shall be heritage cast iron.

A.7.11 Rainwater Harvesting

Not applicable

A.7.12 Grey Water Recycling

Not applicable

A.7.13 Builderswork Associated with the Public Health Services Installations

In addition to all other specified requirements, the Contractor shall include for forming all necessary holes in structure up to 100mm x 100mm for passage of services and for fire stopping all such holes.

A.7.14 Testing Commissioning, and Documentation

Testing Commissioning, and Documentation shall be provided as detailed elsewhere in the Specification.

A.7.15 Record Drawings and Operation & Maintenance Manuals

Record Drawings and Operation & Maintenance Manuals shall be provided as detailed elsewhere in the Specification.

A.7.16 Planned Preventative Maintenance

The Contractor is to include the maintenance of the complete public health services installations from the time of Practical Completion until the end of the 12 months Warranty Period as detailed in Section I of the Specification.

A.8 SUMMARY OF WORK EXCLUDED FROM THIS SUB-CONTRACT

The following work associated with the services installations shall be carried out by Others, which may or may not be within the Contract:

- Mechanical and Electrical installations other than those described in this Specification and/or on the Design Drawings
- Builderswork unless otherwise stated
- The supply of some or all of Luminaires
- The supply and installation of Kitchen equipment
- The supply and installation of Laundry equipment
- The supply and installation of Telephone Hand Sets and PBX equipment
- The supply and installation of Audio Visual Equipment and digital signal capture equipment
- The supply and installation of Broadband and Internet Hardware

B.1 GENERAL

B.1.1 SCOPE
B.1.2 DEFINITIONS AND INTERPRETATION
B.1.3 NAMES OF PARTIES
B.1.4 LOCATION OF THE WORKS
B.1.5 GENERAL DESCRIPTION OF THE WORKS

B.2 STANDARDS OF SPECIFICATION

B.2.1 SPECIFICATION REQUIREMENTS
B.2.2 BUILDING REGULATIONS AND PLANNING REGULATIONS
B.2.3 BRITISH AND EUROPEAN STANDARDS, CODES AND REGULATIONS
B.2.4 ELECTRICAL COMPATIBILITY
B.2.5 DELETERIOUS MATERIALS

B.3 WORKING PRACTICES

B.3.1 GENERAL
B.3.2 COMPETENCE OF SERVICES CONTRACTOR
B.3.3 THE PROGRAMME
B.3.4 SERVICES CONTRACTORS DRAWINGS
B.3.5 MANUFACTURERS INSTRUCTIONS
B.3.6 PLANT
B.3.7 PROTECTION OF MATERIALS AND WORK
B.3.8 TEMPORARY PLUGS
B.3.9 CO-OPERATION WITH OTHER TRADES
B.3.11 SETTING OUT OF WORK
B.3.12 BUILDERSWORK
B.3.13 ACCESS

B.4 QUALITY CONTROL

B.4.1 SUPERVISION
B.4.2 WORKMANSHIP
B.4.3 ROUTING OF SERVICE
B.4.4 DAMAGE
B.4.5 CO-ORDINATION
B.4.6 MATERIALS
B.4.7 SAMPLES FOR APPROVAL
B.4.8 PROTECTION AGAINST CORROSION AND FROST

B.5 COMPLETION OF WORK

B.5.1 PRACTICAL COMPLETION
B.5.2 COMPLETION
B.5.3 INSTRUCTIONS TO EMPLOYERS REPRESENTATIVES
B.5.4 DECORATIVE FINISHES
B.5.5 TOOLS AND ACCESSORIES
B.5.6 SPARES
B.5.7 DEFECTS LIABILITY
B.5.8 MANUFACTURERS GUARANTEES AND WARRANTIES

B.6 HEALTH & SAFETY

B.6.1 PRACTICAL COMPLETION
B.6.2 CONSTRUCTION (DESIGN & MANAGEMENT) REGULATIONS (CDM REGULATIONS)
B.6.3 HEALTH & SAFETY AT WORK
B.6.4 SAFE ACCESS
B.6.5 RESTRICTED HEADROOM
B.6.6 SAFE TEMPERATURES FOR DOMESTIC HOT WATER AT POINT OF USE
B.6.7 SAFE SURFACE TEMPERATURES
B.6.8 'PERMIT TO WORK' PROCEDURES
B.6.9 'HOT WORKING PERMIT' PROCEDURES
B.6.10 CUTTING, GRINDING AND WELDING
B.6.11 ON-SITE SAFETY RECORDS
B.6.12 ASBESTOS MATERIALS

B.7 ENERGY EFFICIENCY

B.7.1 GENERAL REQUIREMENTS
B.7.2 HEATING SYSTEMS CONTROLS
B.7.3 DOMESTIC HOT WATER CONTROLS
B.7.4 LIMITING HEAT LOSS FROM LPHW HEATING, DOMESTIC HOT WATER SERVICES AND VENTILATION SERVICES
B.7.5 LIMITING EXPOSURE TO SOLAR OVERHEATING
B.7.6 PROVISION OF ENERGY EFFICIENT AIR CONDITIONING AND MECHANICAL VENTILATION
B.7.7 PROVISION OF ENERGY EFFICIENT LIGHTING SYSTEMS
B.7.8 INSTALLATION OF ENERGY METERS
B.7.8.1 RESIDENTIAL PROJECTS
B.7.9 RESIDENTIAL PROJECTS – HOME USER GUIDE (CODE FOR SUSTAINABLE HOMES AND BREEAM STANDARDS)

B.1 GENERAL

B.1.1 Scope

The complete Specification, appendices thereto, and the accompanying design drawings, when read together, set out the complete contract requirement with regard to the Mechanical and Electrical Services Installation.

This section of the Specification describes the General Requirements relating to the Services Installation.

The Design Drawings and the Specification shall form a single entity, be complementary to each other and all items shown or described in either or both shall be provided within the tender sum.

Section B is common to both Electrical and Mechanical Services Installations. Where Section B applies to a Contract comprising Electrical and Mechanical Services Works all clauses shall be adhered to. Where the Contract comprises either Mechanical Services Works or Electrical Services Works, any reference to materials and/or workmanship of elements of the installation that are obviously outside of the scope of this particular Installation, shall be disregarded.

B.1.2 Definitions and Interpretation

Within this Specification and the accompanying Drawings the following words and phrases shall have the following meanings:

The Employer shall mean:
The Company, Firm or Person who has entered into contract with the Main Contractor for the procurement of the Contract Works.

The Employer's Consultants or Design Team shall mean the Companies, Firms or Persons employed by the Employer to provide professional services in connection with the design and administration of the Contract Works.

The Employer's Requirements shall mean:
The minimum requirements of the Employer as set out in the Tender Documentation and subsequent amendments.

The Architect and/or Supervising Officer shall mean:
The Company, Firm or Person employed by the Employer to act under the terms of the Contract to instruct the Main Contractor with regard to the Contract requirements.

The Tender Administrator shall mean:
The Company, Firm or Person appointed by the Employer to issue Tender Documents and receive Contractors Tenders and to deal with matters arising in connection.

The Engineer or Services Consultant shall mean:
The Company, Firm or Person employed as the Services Consultant.

The Contractor or Main Contractor shall mean:
The Company, Firm or Person employed by the Employer to undertake the complete Contract Works. The term Contractor or Main Contractor shall always include all Sub-Contractors to the Main Contractor.

The Design/Install Contractor shall mean:
The Company, Firm or Person employed by the Employer to undertake the complete Contract Works which shall include the detail design of the Services Installations, whether this is as a Domestic, Nominated, or Named Sub-Contractor.

The Builder or Builderswork Contractor shall mean:
The Company, Firm or Person employed by the Main Contractor to carry out the builders work required in connection with the services works.

The Services Contractor shall mean:
Either - The Company, Firm or Person employed by the Main Contractor as a Sub-Contractor to carry out the Engineering Works specified herein, whether this be as a Domestic, Nominated, or Named Sub-Contractor,
Or - The Company, Firm or Person employed by the Employer to carry out the Engineering Works specified herein in the case where no Main Contractor is employed.

The Specialist or Specialist Installer shall mean:
The Company, Firm or Person employed either as a Sub-Contractor to the Main Contractor or as a Sub-Contractor to the Services Contractor to carry out specific elements of the Services Installation which require particular specialization and expertise.

Other Contractor(s) or Others shall mean:
Any Contractor employed by the Employer or by the Main Contractor to undertake work within or adjacent to the Works other than the Main Contractor or the Services Contractor.

The CDM Coordinator shall mean:
The Company, Firm or Person appointed by the Employer in accordance with the requirements of the Construction (Design & Management) Regulations 2015– now superseded by the Principal Designer.

The Principal Designer shall mean:
The Company, Firm or Person appointed by the Employer in accordance with the requirements of the Construction (Design & Management) Regulations 2015 and subsequent amendments.

The Principal Contractor shall mean:
The Company, Firm or Person identified within the Contract as the Principal Contractor in accordance with CDM Regulations.

The Contract or Main Contract shall mean:
The Contract entered into between the Employer and the Main Contractor for the execution of the complete Contract Works.

The Sub-Contract shall mean:
The Contract entered into between the Main Contractor and the Service Contractor for the execution of the Services Installations specified herein, whether this is with a Domestic, Nominated or Named Sub-Contractor.

The Contract Works or Main Contract Works shall mean:
The construction of all elements of the Main Contract requirements as defined within the Main Contract and which shall include the Services Installation.

The Services Installation or Engineering Works shall mean:
The installation of Mechanical, Electrical and Public Health and Sanitation Building Services to be undertaken by the Services Contractor in accordance with the Specification and the Design Drawings as applicable.

The Site or Building Site shall mean:
The designated geographical area within which the Main Contract Works are to be undertaken including the Contractors storage, welfare and office facilities.

The Builderswork or Builders Work shall mean:
The general building works such as forming openings in walls and floors, constructing plant bases, chasing masonry walls and making good which is required in connection with the installation of mechanical and electrical services and which is to be undertaken by the Builder.

The Specification shall mean:
The documents prepared by the Services Consultant which shall be read in conjunction with the Design Drawings to specify the equipment, materials and workmanship to be adopted by the Services Contractor in the execution of the Services Installation.

The Performance Specification shall mean:
The documents prepared by the Services Consultant which shall be read in conjunction with the Design Drawings to specify the design intent, equipment, materials and workmanship to be adopted by the Services Contractor in undertaking the detailed design and the execution of the Services Installation.

The Design Drawings shall mean:
The Design Drawings prepared by the Services Consultant to be read in conjunction with the Specification to fully illustrate and detail the Services Installation.

The Tender Drawings shall mean:
The issue of the Design Drawings prepared by the Services Consultant to be used in conjunction with the Specification or Performance Specification to obtain competitive tenders for the works.

The Services Consultant's "For Construction Stage" Drawings shall mean:
The issue of the Design Drawings prepared by the Services Consultant and issued from time to during the course of the Installation Woks to illustrate and detail the Services Installation and changes thereto and which shall be used as the basis for the preparation of the Services Contractors' Installation Drawings.

The Builders Work and Installation (Working) Drawings shall mean:
The issue of Builders Work and Installation (Working) Drawings prepared by the Services Contractor to be used for the purpose of the construction of the Services Works.

Equal and Approved shall mean:
The written approval given by the Services Consultant, Architect, Supervising Officer or Project Manager with respect to alternatives proposed by the Services Contractor but which shall not limit any requirements of the Contract in relation to the performance and quality of materials, goods and workmanship.

Approval, Approved By, To The Approval, As Directed and similar terms shall mean:
The written approval or written direction given by the Services Consultant, Architect, Supervising Officer or Project Manager which shall not limit any requirements of the Contract, particularly in relation to the performance and quality of materials, goods and workmanship.

And Note

Words in the singular shall include the plural meaning and words in the plural shall include the singular meaning.

The use of any specific gender term shall mean all genders.

Headings shall be regarded as for reference only and shall not affect the meaning or interpretation of the body text.

Reference to any Act, Regulation, Code of Practice or Statutory Code shall be interpreted to include any change, re-enactment, or extension of the Act, Regulation, Code of Practice or Statutory Code.

The term "persons" shall include natural persons, firms, partnerships, companies, corporations, associations, and organisations and all these terms shall be interchangeable.

The following abbreviations shall mean:

- ACOP L8 The Control of Legionella Bacteria in Water Systems issued by HSC
- ACRIB Air Conditioning and Refrigeration Industry Board
- BAFE British Approvals for Fire Equipment
- BS, or BS EN British Standard Specification issued by the BSI
- BSI British Standard Institute
- BRE Building Research Establishment
- Certbuild Registered Safety Standard administered WRc and NSF
- CDM The Construction (Design & Management) Regulations 2007 or 2015 as applicable
- CIBSE The Chartered Institute of Building Services Engineers
- COP Code of Practice issued by the BSI
- CORGI Confederation of Registered Gas Installers – now GSR
- EHO Environmental Health Office representing the Local Authority
- EN European Standard Specification
- FO Fire Officer representing the Fire Brigade/Local Authority
- GSR Gas Safety Register – administered by Capita Group Plc under authority of HSE
- HSC The Health & Safety Commission
- HSE Health & Safety Executive
- HS(g)70 The Control of Legionnaires Disease Regulations 1991 issued by HSE
- HVCA Heating and Ventilation Contractors Association
- IEE The Institute of Electrical Engineers
- IOP Institute of Plumbing
- LA Local Authority
- LPC(B) Loss Prevention Council (Board) administered by BRE
- NACOSS National Approval Council for Security Systems – now NSI
- NSI National Security Inspectorate
- NICEIC National Inspection Council for Electrical Installation Contractors
- OFTEC Oil Firing Technical Association
- WRAS Water Regulations Advisory Scheme
- WEEE The Waste Electrical and Electronic Equipment Directive (EU)
- RoHS The Restriction of Hazardous Substances Directive (EU)

B.1.3 Names of Parties

See Section A, Clause A.2 for details of the Names of Parties.

B.1.4 Location of the Works

See Section A, Clause A.3 for details of the Location of the Works.

B.1.5 General Description of the Works

See Section A, Clause A.4 for details the General Description of the Works.

B.2 STANDARDS OF SPECIFICATION

B.2.1 Specification Requirements

This Specification together with the Design Drawings, and any subsequent variations and amendments, shall provide the Specification Requirements which the Services Contractor shall comply with throughout the Works. In the event of any discrepancy between the Specification and the Design Drawings or any other Contract Document, the Services Contractor shall immediately seek clarification.

In the event that the Services Contractor is unable to comply with the Specification Requirements, for whatever reason, the Services Contractor shall seek, in writing, immediate further instruction or clarification.

The Services Contractor shall be responsible for accurately conveying the requirements of this Specification to manufacturers and suppliers. The Services Contractor shall not rely on the accuracy or suitability of quotations issued by manufacturers and suppliers.

Where a manufacturer/supplier reference or a manufacturer/supplier quotation is included in the Specification or the Design Drawings, the Services Contractor ensure that that the item of plant or equipment does meet Specification Requirements.

B.2.2 Building Regulations and Planning Regulations

Services Installations shall be in accordance with the relevant issue of the Building Regulations as issued by the Secretary of State for England and Wales or for Scotland as appropriate.

Notwithstanding details of plant equipment and materials specified elsewhere in this Specification the Services Contractor shall ensure that all parts of this installation shall comply with the requirements of the Local Authority Building Control Department and the Planning Authority.

The Services Contractor shall formally request from the Architect copies of the relevant permissions together with schedules of conditions.

Building Control shall include the requirements of the Environmental Health Officer, the Fire Prevention Officer and the Petroleum Officer.

The Services Contractor shall immediately notify the Engineer of any instances where the Services Installations are not in compliance with the Building Regulations and Planning Regulations.

B.2.3 British and European Standards, Codes and Regulations

Notwithstanding details of plant equipment and materials specified elsewhere in this Specification the Services Contractor shall ensure that all parts of this installation shall comply with standards laid down by the latest, editions of or amendments to, the following Specifications, Regulations, Directives and Acts of Parliament wherever applicable:

- BS 7671 (IEE Wiring Regulations)
- The Factories Act
- The Health and Safety at Work Act
- The Clean Air Act
- Water Supply (Water Fittings) Regulations 1999 and WRAS Guidance
- Water Supply Company Regulations
- BS EN 806, BS 8558, and The Water Supply Bylaws and Water Supply Byelaws Guide
- The Electricity Supply Authorities Regulations
- British & European Standard Specifications and Codes of Practice issued by BSI/EN
- The Offices, Shops and Railway Premises Act.
- All Statutory Notices and By-Laws
- The Gas Safety Regulations
- The Gas Supply Authorities Regulations
- The requirements of ACOP L8
- The Construction (Design & Management) Regulations 2007 and 2015 as applicable
- The Fire Precautions (Workplace) Regulations 1997
- The Management Of Health And Safety At Work Regulations 1999
- Construction Products Regulations (CPR) 1992
- Disability Discrimination Act 1995
- OFTEC (Oil Firing Technical Association) Codes of Practice
- Gas Safe (HSE) Codes of Practice
- The Domestic Building Services Guide 2010 issued by HM Government
- The EU Waste Electrical and Electronic Equipment Directive (WEEE) 2004
- The EU Restriction of Hazardous Substances Directive (RoHS)

B.2.4 Electrical Compatibility

All equipment to be supplied by the Services Contractor requiring an electrical supply, other than equipment designed to be operated by means of designated individual power supply unit, shall be suitable for the electrical supply system in the United Kingdom and in accordance with the requirements of BS 7671. This shall mean that equipment to be provided with a mains electrical supply shall be suitable for either a 230 volt single phase 50 Hz supply or a 400 volt 3 phase 50 Hz supply.

Where equipment is supplied by the manufacturer complete with electrical plug top, this shall be to BS 1363 and BS 7671. On site modification shall not be accepted.

B.2.5 Deleterious Materials

The Services Contractor shall not incorporate any Deleterious Materials into the Works.

This includes any substances generally known to be deleterious at the time of installation or are accepted as being capable of becoming deleterious when used in a particular situation or in combination with other materials.

Deleterious materials shall include, but not limited to any materials which are:
i) Not in accordance with relevant British and European (EN) Standard Specifications.
ii) Publicized in the Building Research Establishment Digests as being hazardous to health and safety.

Any material (or combination of materials) shall be regarded being deleterious if its use would have the effect of reducing the life expectancy of the material itself, any material to which it is fixed, or the structure in which it is incorporated to a period less than that specified by the manufacturer of the material, or as prescribed by a recognized building research establishment or code of practice.

The Services Contractor shall ensure that materials and equipment incorporated into the works contain no asbestos.

Materials containing lead including solder shall not be used in connection with any pipework or equipment used to convey or store domestic hot and cold water services.

Pipe joints using hemp and jointing compound shall not be used in connection with any pipework or equipment used to convey or store domestic hot and cold water services.

Refrigerants for use in air conditioning equipment shall comply with UK and EU requirements for new installations, be non-Ozone Depleting Substances.

Thermal insulation, air filtration media, acoustic performance materials and sealants shall contain no substances containing fibres of size 200 micron long or less and 3.0 micron diameter or less.

Polyurethane, Polystyrene or Polyisocyanurate foams, shall not be incorporated in the Works, except that in the case where there is no available alternative to the use of Polyurethane or Polystyrene foams and only where these are provided as part of a manufactured item of specialist equipment. In such circumstances the Services Contractor may seek a waiver to this clause.

B.3 WORKING PRACTICES

B.3.1 General

The following section of the Specification describes the methods of working which shall be adopted by the Services Contractor in undertaking the installation of the Services Installations and the general level of competence required of the Services Contractor.

B.3.2 Competence of Services Contractor

Services Contractors shall be experienced and competent in the nature and scale of the works to be undertaken and Services Contractors and their operatives on Site shall be registered with the relevant trade and/or professional regulatory bodies.

Electrical installations within residential premises including associated common areas, and in any building served by an electricity supply emanating from a residential premises, and in any building from where an electrical supply is extended to serve a Residential Premises, shall be undertaken in accordance with Part P of the Building Regulations. In all such situations only personnel certified as being a 'competent person' as defined by the Building Regulations Part P may carry out any electrical installation work.

Only registered NICEIC Contractors shall undertake any works associated with electrical installations. All operative engaged on the installation of electrical services shall be qualified electricians and shall be individually registered with an appropriate trade organisation such as NICEIC.

Only suitably Gas Safety Registered Contractors (Gas Safety Registration Scheme) shall undertake any works associated with gas installations. Such registration shall be appropriate for nature of the work to be undertaken.

Only Contractors registered with the National Security Inspectorate (NSI) under the Gold membership standard shall either undertake any works in connection with, or maintain/service, any installation of Security Services.

Only Contractors registered under the REFCOM scheme administered by the ACRIB shall undertake any works associated with refrigeration systems and all operatives engaged on such works shall be personally registered under the Safe Refrigerant Handling scheme administrated by ACRIB.

Only OFTEC registered operatives shall undertake works associated with fuel oil installations including installation of oil fired equipment.

B.3.3 The Programme

The Main Contractor shall develop and issue the Contract Programme for the approval of the Architect. Once approved the Main Contractor shall issue the Contract Programme to all parties including Sub-Contractors. The Contract Programme shall remain un-amended until contract completion and progress shall be monitored against the Contract Programme.

Any amendments to the programme necessitated by re-phasing and to account for delays and /or acceleration in the progress of the Works and the expansion of the Contract Programme to include more detail, shall be illustrated by means of a Working Programme which shall be provided and maintained up to date by the Contractor.

The Services Installations shall be programmed into the overall contract period to ensure that all off site and on site activities are properly considered and evaluated with sufficient time being allocated for survey works, production and approval of Services Contractors drawings, installation works, testing and commissioning and production of record documentation.

B.3.4 Services Contractors Drawings

The Services Contractor shall not commence installation of the Mechanical and Electrical services until the Services Contractor is possession of approved Installation Drawings all as detailed in Section I of this Specification.

The Services Contractor shall install services in accordance with the approved Installation Drawings

Work not in accordance with the approved Installation Drawings shall be removed and correctly reinstated at the Services Contractors expense.

B.3.5 Manufacturers Instructions

The Services Contractor shall comply with all preparation, installation and operational instructions provided by, or made available by, the supplier or manufacturer of any item to be used in the installation works.

The Services Contractor shall immediately notify the Services Consultant if he is unable to comply fully with any manufacturer's instruction.

B.3.6 Plant

The Services Contractor shall provide all plant, implements, tools, tackle and machinery and all craneage and hoisting apparatus as required for the proper and efficient execution of the works.

The Services Contractor shall ensure that only suitably trained operatives are permitted to operate site equipment.

B.3.7 Protection of Materials and Work

The Services Contractor shall take every precaution to protect their work and materials from damage by other trades.

The Services Contractor shall be responsible for the protection of all works under this contract until such works or parts thereof are accepted by the Services Consultant on behalf of the Employer, as being Practically Complete and a Certificate to that effect is issued.

The Services Contractor shall include within their Tender for all necessary protection, which shall be suitable for the location and prevailing site conditions.

The Services Contractor shall be responsible for any damage to the Services Installation resulting from absence or inadequate protection of their work and the Services Contractor shall be responsible for repairing any damage so caused, at no cost to the contract and without delay to the Programme.

B.3.8 Temporary Plugs

All pipework open ends shall be fitted with plugs as the works proceed at site. Plugs shall be plastic, malleable iron or copper stop-ends. Under no circumstances shall non-approved materials be used.

B.3.9 Co-operation with Other Trades

The Services Contractor shall acquaint himself with the general arrangement of all installation works which form part of the Contract and ensure that in fixing their work it will not obstruct the fixing or future maintenance of any other services.

In occupied buildings, the Services Contractor shall fully co-operate with the occupier and shall take all reasonable precautions to ensure that the reasonable activities of maintenance staff and other contractors are not obstructed.

B.3.10 Working in Occupied Areas

Not Applicable

B.3.11 Setting Out of Work

The Services Contractor shall include for true and proper setting out of the contract works. The setting out shall be carried out by experienced operatives with the appropriate equipment to ensure that the contract works are fixed correctly in relation to the building and fittings attached to it.

The precise positioning of all items of equipment shall be in accordance with dimensioned information provided by Architects Instructions.

The Services Contractor shall install items of internal and external exposed-to-view equipment, such as luminaires, switches, socket outlets and thermostats, to confirmed setting out dimensions to be provided by the Architect. This does not apply to equipment installed in plant rooms, services voids and services cupboards however ALL equipment wherever located shall be positioned on the Services Contractors Installation drawings.

Subject to the requirements of venting and draining, pipework, ductwork, conduit and trunking services shall wherever possible, be routed either perpendicular to or parallel to the floor level.

All measurements shall be taken from site measurements whenever possible. Drawings shall not be scaled.

B.3.12 Builderswork

Builderswork required in connection with the installation of mechanical and electrical services shall be carried out by the Main Contractor with the exception that the Services Contractor shall undertake chasing for electrical conduit and accessories and holes through non-structural building elements up to 50mm.

The Services Contractor shall be responsible for producing dimensioned Builderswork drawings which set out the accurate position of all builders work requirements and for the marking up on site of positions of floor and wall holes and chases. Work shall not proceed until Builderswork drawings are approved by the Architect.

The Services Contractor shall check the accuracy of all builderswork carried out by the Main Contractor and report any discrepancies prior to the commencement of the installation of service.

B.3.13 Access

The Services Contractor shall ensure all parts of the services installation remain fully accessible until all testing and commissioning is complete and has been accepted by the Services Consultant as satisfactory. Phased testing and concealment may be acceptable subject to prior agreement.

The Services Contractor shall ensure all items of equipment shall be provided with permanent access. This shall include balancing, measuring and commissioning equipment, fire dampers, electrical connections/joints, drain down valves, air admittance and air release valve and access doors and rodding eyes in drains and soil and waste pipes and any item of equipment requiring replacement, maintenance and adjustment.

The Services Contractor shall provide details of locations and sizes of all required access panels into ceilings, floors and service voids for consideration and comment by the Architect.

Internal and external plant and equipment shall be positioned in accordance with the manufacturer's instructions to ensure sufficient access is provided for maintenance.

B.4 QUALITY CONTROL

B.4.1 Supervision

The Services Contractor shall, during the whole time that the works are in progress, maintain on site a qualified competent non-working or part-working Foreman who shall be have the Services Contractors authority to take and carry out the instructions given to him by the Main Contractor.

The Services Contractor shall appoint a Project Engineer to take day to day responsibility for the works and who shall be available as required to attend Site Meetings.

B.4.2 Workmanship

All work shall be carried out by fully trained and properly supervised tradesmen in a neat and workmanlike manner in accordance with good trade practice.

The Services Contractor's operatives employed upon the work shall have received a good training in their trade, shall possess a high standard of skill and be fully qualified and competent to carry out the work. Where, in his opinion, any operative is not so qualified, the Services Consultant or his representative may request the Services Contractor to replace this operative.

The proportion of skilled to unskilled labour employed on the work shall be as approved by National Agreement.

All workmanship shall be to the highest standards.

B.4.3 Routing of Service

The installation of mechanical and electrical services shall follow the principals indicated on the Design Drawings and as described in the Specification. Where no guidance is provided the Services Contractor shall propose suitable solutions for the vertical and horizontal routing of services based on drawings provided by the Architect and Structural Engineer.

Generally horizontal services other than electrical conduit shall be routed within ceiling voids and/or floor voids. Routing of services through floor structure shall be avoided.

Electrical conduit shall be designed to allow replacement of cables. Electrical services shall not be routed through areas of raised temperature such as above underfloor heating pipework.

Where services are indicated as being routed within horizontal floor ducts, sufficient permanent access through the floors shall be provided to enable installation, repair and maintenance and to meet the requirements of relevant regulations. Domestic water pipework shall be fully accessible to enable replacement.

Floor ducts containing water pipework shall be provided with leak detection throughout the duct length. Underfloor heating systems shall not extend over floor access positions.

All services routes shall be provided with suitable access for installation, repair and maintenance.

Fixings to structure, openings through structure and any cutting away, notching or drilling through structural timber members shall be approved by the Structural Engineer.

B.4.4 Damage

The Services Contractor shall take all possible practical measures to prevent damage to property, fixtures and fittings, and decorations that may arise in connection with the contract.

Necessary provision shall be made for the prevention of stains to floors, walls and ceilings due to water, lubricants and debris from tools, machinery and fittings. Cutting and screwing of conduit and pipework shall not be undertaken on the finished floors, unless adequate protection is provided.

Any damage shall be made good at the cost of the Services Contractor.

B.4.5 Co-ordination

The Services Contractor shall be responsible for co-ordinating the installation of his own services and for co-ordinating his services with the installations of other contractors installations and for coordinating his services with the structure and the fabric of the building.

The Services Contractor shall ensure that he is in possession of all relevant information prior to producing Installation drawings. This shall include up to date structural and architectural details as well as installation drawings provided by other contractors.

The Services Contractor shall request in writing in good time to meet the programme, any additional information required in order to produce fully coordinated Installation drawings.

The Services Contractor shall notify the Architect at the earliest opportunity of any discrepancies within the information provided to him where this impacts on the installation of his services and any instances where the proper coordinated installation of his services cannot be achieved and the Services Contractor shall await further instruction before proceeding.

B.4.6 Materials

All materials to be used throughout the Contract shall originate from countries within the European Union (EU), unless otherwise specified. All materials originating from countries within the EU to be incorporated into the Works shall be 'CE' marked and the Service Contractor shall provide a certificate of 'Declaration of Conformity' from either the manufacturer or the supplier.

Where the Services Contractor intends to use any materials originating from outside the EU, full details of these shall first be submitted to the Services Consultant for approval and these shall only be used in the Works after the Services Consultant has given written approval for this.

All materials used shall be of the best of their particular type and the Services Contractor may be called upon to submit for approval samples of the various materials intended to be used in the execution of the work.

All materials shall comply with the appropriate current standard issued by the British (BS) and/or European (EN) Standards Institutions.

The Services Consultant shall reject any materials or plant which are of inferior quality, or do not conform to the Specification.

The Services Contractor shall not substitute specified materials for alternative materials without the written consent of the Engineer.

B.4.7 Samples for Approval

The Services Contractor shall submit for the Services Consultants consideration such samples of workmanship, materials and equipment intended for execution of the Works, as the Services Consultant considers necessary.

Samples will remain in the possession of the Services Consultant until contract completion or be incorporated into the installation.

The Service Contractor shall provide, as a minimum, one sample of each of the following for approval:
Each visibly different type of luminaire
Each visibly different type of electrical accessory
Visible fire alarm equipment items
Door entry equipment items
Intruder Alarm and CCTV equipment items
Thermostat and temperature sensors

B.4.8 Protection against Corrosion and Frost

The Services Contractor shall be responsible for ensuring the complete installation is protected against the risk of corrosion. This shall be by selection of suitable materials and components for the environment and by application of suitable paints and protective finishes as appropriate.

As the work proceeds, all steel pipework shall be thoroughly wire brushed and cleaned of all rust, dirt and grease and be painted as a protection against rust with one coat of red oxide paint, this work being performed by the Services Contractor.

Steel conduit and fittings where not galvanised shall be supplied with protective lacquer. The Services Contractor shall take be responsible for repairing any damage to this finish.

Where galvanised pipe and conduit is to be threaded, the Services Contractor shall ensure that the minimum possible length of threading is exposed after assembly and that any exposed threading is treated with cold galvanising paint.

All steel brackets and fixings shall be fabricated at works and painted one coat of zinc chromate before delivery to the site. Steel brackets and fixings for external positions exposed to weather shall be galvanised after manufacture.

All nuts, bolts and washers, pipe brackets/clips, drop rods and studding shall be stainless steel.

The Services Contractor shall be responsible for ensuring the installation is protected against frost damage. All pipework at risk of freezing shall be left drained of water other than specifically during testing and commissioning operations.

B.5 COMPLETION OF WORK

B.5.1 Practical Completion

The Installation shall be Practically Complete when all the following have been satisfied:

- The Works are complete to the extent that only minor making good/remedial works are required to be completed and that there are no outstanding or defective Contract Works which could have a disadvantage to the Employer or Occupier in terms of Compliance with Planning Requirements and Building Regulations, Health & Safety, Performance, Reliability, Running Costs, Noise and Operation.
- The Contract Supervisor/Architect has issued a “Certificate of Practical Completion” covering all the Contract Works
- The Client is in possession of an approved complete set of Record Drawings and Operating and Maintenance Manuals
- The Services Contractor has demonstrated the operation of the installation systems to the Employer/Occupier
- The Services Contractor has provided the Employer/Occupier with a 12 month Maintenance Contract for the installation (where this is a specified requirement under the Contract)

At Practical Completion of the works, the Services Contractor shall remove from site all unused materials, packaging, and debris, clean any apparatus which may have become dirty and shall carry out any other adjustment, tidying up or other work which in the reasonable opinion of the Services Consultant may be necessary, or beneficial, to the final appearance of the works.

B.5.2 Completion

The Installation shall be Complete when all the following have been satisfied:

- All the requirements of Practical Completion as scheduled above have been met
- The Contract Supervisor/Architect has issued an unqualified ‘Completion Certificate’ covering all the Contract Works
- The Contract Supervisor/Architect has issued an unqualified a ‘Making Good of Defects Certificate’ as appropriate

On satisfactory completion of all commissioning work and following the Services Consultants written approval of the commissioning reports, the Services Contractor shall replace all filters in air handling plants with new media. The Services Contractor shall also remove, clean and replace the washable filters in all fan coils, fan convectors and fan door heaters.

B.5.3 Instructions to Employers Representatives

After completion of the tests on the installation and acceptance by the Services Consultant, the Services Contractor is to allow for a competent engineer to supervise the running of the services installations for a period of one day during which period he is to give full instructions to the Employers or Occupiers Maintenance Staff on the proper operation and the maintenance of the services installations and on emergency and safety procedures.

B.5.4 Decorative Finishes

The finishing paintwork of all of the services installations which form part of this Contract shall be carried out by the Services Contractor to colours and details specified by the Architect but the Services Contractor shall make the following allowance in his Tender:

Bare steel tube and fittings either exposed to atmosphere or within plant rooms and service shafts:
Red oxide primer coat with 1 coat oil based undercoat 2 coats oil based black gloss paint (Gas pipe to be painted yellow)

Internal bare steel tube and fittings where insulated and/or concealed from view within floor and ceiling voids:
Red oxide primer coat

Bare copper tube and fittings:
Cleaned of all flux and left unpainted. Tube is to be polished where exposed to view internally.

Bare copper tube - final exposed-to-view connections to sanitary ware:
To be run in polished chrome pipe and fittings

Cast iron valves, and other items of pipeline equipment:
Painted 2 coats oil based gloss paint

Brass and gunmetal valves and other items of pipeline equipment:
Cleaned of all dirt etc and left unpainted

Plant items provided with manufacturers own final paint finish:
To be left with manufacturers finish. Any damage to original finish is to be repaired.

Brackets, gantries and supports within plant rooms and service areas:
Red oxide primer coat with 1 coat oil based undercoat 2 coats oil based gloss paint

Brackets, gantries and supports - exposed to weather:
Galvanised after manufacture and left for decoration by others

Ventilation ductwork where exposed-to view:
Left galvanized finish unless specified otherwise

Grilles diffusers and louvres:
To be stove enamel or powder coat finish to approved BS or RAL colour to be specified

Radiators:
To be left with manufacturers primer finish for decoration by Others.

Air conditioning Units, Convector Heaters and other Cased Room Units:
To be left with manufacturers finish. Any damage to original finish is to be repaired.

B.5.5 Tools and Accessories

On Completion the Services Contractor shall hand over to the Employer all specialist tools and accessories supplied by manufacturers and suppliers to assist in the installation, servicing and removal or items of equipment.

Tools and accessories shall be presented in suitable durable containers together with a full written schedule of items.

B.5.6 Spares

On completion of the works and prior to the issue of the Practical Completion Certificate, the Service Contractor shall, as part of his Contract, provide the following spare parts and items which shall be presented in the manufacturers packaging with each item clearly labelled as to precise purpose:

- Replaceable Filter Media - Ventilation systems - One spare set of bags or cartridges for each filter unit installed
- Washable Filter Media - Fan Coil Units, Fan Convectors, over door heaters - One spare filter medium cartridges of each type/size installed
- Fuses, MCBS and RCDS - One spare items for each different size/rating/type installed
- Fan/Pump Drive Belts - One set of drive belts for each different type of unit installed
- Thermostatic Radiator Valves - One spare complete valve sets for each valve size and type installed
- Air Release Valve Keys - Two sets of keys for each different type of valve installed
- Valve Keys (LSV, Gas Valves) - Two sets of keys for each different type/size of valve installed
- Control Panel Keys - Two sets of keys for each panel lock (total of 3 sets of keys per lock)
- Water Treatment Chemicals - sufficient spare chemicals as recommended by Specialist for 3 months operation of all systems
- Fluorescent lamps - Two lamps for each different type/size of luminaire installed

- Key Operated Electrical Switches - Two keys of each type

B.5.7 Defects Liability

The Defects Liability Period shall commence at the issue if the Practical Completion Certificate as certified by the Architect but the Employer shall notwithstanding, be at liberty to use the works during the said period.

In the absence of a stated period of liability within the Contract documents, the Defects Liability Period shall be 12 months. In the event that a Practical Completion Certificate is not issued or is delayed, the Defects Liability Period shall commence when the Employer starts to receive beneficial use of the building services installation.
The Services Contractor shall rectify any unapproved deviation from the specification requirements and any defect due to materials and/or workmanship which may be discovered or become apparent during the Defects Liability Period.

The Services Contractor shall carry out all remedial works in a timely and approved manner and at no cost to the Employer.

On being instructed to undertake remedial works, the Services Contractor shall without delay inspect the works and confirm the best achievable programme and proposed methodology for undertaking the required remedial work and this is to be agreed with the Employer prior to commencement.

B.5.8 Manufacturers Guarantees and Warranties

The Services Contractor shall arrange for the benefit of all manufacturers and suppliers guarantees and warranties for plant and equipment to be assigned to the Employer on completion of the Contract. This shall not limit the responsibility of the Services Contractor to rectify any defects under the terms of the Contract.

Guarantees and warranties shall be extended at least until the end of the defects liability period.

Where the manufacturer's warranty extends beyond the expiry of the contract Defects Liability period, the benefit of the manufacturer's full warranty shall be made available to the Employer.

B.6 HEALTH & SAFETY

B.6.1 Practical Completion

A Practical Completion Certificate will not be issued if any works, which could affect the health and safety of the occupants, their agents or the public, are incomplete, not fully operational or are non-compliant.

The safety items specified or indicated on the drawings such as fire stopping penetrations through fire walls/floors ductwork fire and smoke dampers, panic alarms and release buttons, safety/pressure relief valves, gas safety shut-off valves, automatic smoke and heat detection, fire alarm audible and visual alarm indication, automatic safety interlocks, instrumentation, must be installed and tested during the normal progression of the contract.

A Practical Completion Certificate will not be issued if any installations have not been fully and satisfactorily tested and commissioned in accordance with the requirements set out in the Specification and if the relevant and satisfactory Test Certificates are not provided by the Services Contractor.

A Practical Completion Certificate will not be issued until an approved Health & Safety File containing the Mechanical and Electrical Maintenance & Operating Instructions and Record Drawings of the Installations is not provided for the use of the Building Users and their Maintenance Contractors.

B.6.2 Construction (Design & Management) Regulations (CDM Regulations)

Unless stated to the contrary, the project shall be subject to the Construction (Design & Management) Regulations 2007 or 2015 as applicable and the Employer shall appoint a CDM Coordinator (CDMC) (2007 Regulations) or a Principal Designer (PD) (2015 Regulations) to administer and monitor the requirements of this legislation.

The Principal Contractor shall be responsible for the satisfactory and prompt production of all necessary Safety Policy Statements, Construction/Demolition Method Statements, and Risk Assessments as may be reasonably requested by the CDMC or PD as applicable.

Where the Services Contractor is not the Principal Contractor, the Services Contractor shall make all necessary contributions to the Health & Safety File and shall promptly provide all information reasonably required by the Principal Contractor.

The Services Contractor shall ensure that his method of working is at all times consistent with the instructions of the CDMC or PD as applicable.

The Services Contractors price for the Works shall include for the full compliance with the CDM Requirements.

B.6.3 Health & Safety At Work

The requirements of the Health and Safety at Work Act 1974 and subsequent amendments shall be fully complied with throughout the progress of the works on site.

B.6.4 Safe Access

The Services Contractor shall take all possible measures to ensure that no elements of the installation are fixed in such a manner or in such positions as to present a potential risk to the safety of personnel requiring access both during and after completion of the Works. The Services Contractor shall bear the cost of any modifications to the installation necessary to comply with this requirement.

The Services Contractor shall define and maintain safe unobstructed access and escape routes through all plant and congested areas. The Services Contractor shall maintain adequate general lighting and emergency escape lighting in all plant and congested areas.

B.6.5 Restricted Headroom

On completion of the Works and prior to Handover, the Services Contractor shall, in conjunction with the Planning Supervisor, identify any elements of the installation which present possible safety risks to personnel and which cannot for technical reasons be resolved by modification. In such cases, the Services Contractor shall place warning signs, apply safety padding, and mark with adhesive plastic warning tape as necessary to warn of the obstruction and to minimise the risk of injury.

B.6.6 Safe Temperatures for Domestic Hot Water at Point of Use

The installation shall comply with Part G3 of the Building Regulations. The temperature of hot water at the point of use shall not exceed 48degC and this shall be achieved by provision of thermostatic blending valves at all points of use except supplies directly connected to kitchen and laundry appliances.

In addition and where applicable installations shall comply with the recommendations of the Buildcert scheme administered by WRc-NSF (Water Research Centre and the National Sanitation Foundation). Certbuild approved thermostatic mixing valves shall be installed at the point of use to limit the maximum water discharge temperatures to the following:

Bidets	38 deg C
Showers	41 deg C
Wash Hand Basins	41 deg C
Baths	44 deg C

In the case of Schools, Hotels, Hostels, Public Buildings (areas of public access), and Social Housing the TMV2 standard shall be adopted. In the case of Hospitals and Healthcare Buildings the TMV3 standard shall be adopted.

B.6.7 Safe Surface Temperatures

During construction, the Services Contractor shall ensure that the surface temperature of any unguarded elements of the installation shall not present a risk of injury. Where possible, hot surfaces shall be insulated or guarded. If this cannot be achieve at all times, for example hot testing pipework, then warning signs shall be provided in hazardous areas.

The completed installation shall comply with Health and Safety and other relevant guidance regarding safe surface temperatures in areas where occupants and visitors might be at risk of injury.

Light fittings shall be designed and positioned to ensure there is no risk of injury resulting from touching high temperature components.

In areas where vulnerable people such as the disabled, the young and the elderly, are likely to be present, hot elements such as radiators and pipework shall be limited to a maximum temperature of 41 deg C. Radiators shall be Low Surface Temperature type and hot pipework shall be thermally insulated and/or otherwise protected.

B.6.8 ‘Permit To Work’ Procedures

In occupied and partially occupied buildings, and in the case of installations where it is necessary to operate parts of the mechanical and electrical installations prior to completion of the Works, the Services Contractor shall, in conjunction with the Main Contractor, operate a ‘Permit To Work’ safety procedure.

In any area of the Site covered by a ‘Permit To Work’ procedure, the Services Contractor shall not commence work on any part of the mechanical or electrical installations, including making connections to existing services, unless first issued with a ‘Permit To Work’ by the Main Contractor which shall state the area of the Site, the services covered, and the start and duration of the permit. The Services Contractor shall comply with all conditions of the permit including the provision of safety equipment, the attendance of suitably trained personnel, and the method of working.

B.6.9 ‘Hot Working Permit’ Procedures

In hazardous areas such as roof voids and service shafts, and in occupied and partially buildings, the Services Contractor shall, in conjunction with the Main Contractor, operate a ‘Hot Working Permit’ safety procedure.

The Services Contractor shall not commence any welding, soldering, brazing or any other hot working activities in any area considered hazardous or in any areas of an occupied building, unless first issued with a ‘Hot Working Permit’ by the Main Contractor which shall state the area covered and the start and duration of the permit. The Services Contractor shall comply with all conditions of the permit including the provision of safety equipment, the attendance of suitably trained personnel, and the method of working.

B.6.10 Cutting, Grinding and Welding

The Services Contractor shall only undertake machine cutting and grinding, gas and arc welding and gas brazing operations in suitable locations agreed with the Main Contractor. Such locations shall incorporate suitable health and safety provisions, protection against spread of fire and fumes, access restrictions, ventilation, and warning notices and shall be managed by trained operatives.

B.6.11 On-Site Safety Records

The Services Contractor shall keep and maintain current, accurate records of the installations, which form this Contract and these records shall be readily available for inspection by the Employer, the Main Contractor and other Sub-Contract staff, the CDM Coordinator, the emergency services, and the professional team.

On-Site Safety Records shall be in the form of marked up drawings which shall clearly indicate the extent and nature of the installed works and the location of any parts of the construction site which present a risk to health and safety.

The records shall indicate the positions of all main electrical isolators, and main gas and water stop valves whether these are temporary or permanent devices.

In occupied and partially occupied buildings, records shall kept of the operational status of all emergency escape lighting, fire detection, fire alarm, and fire fighting systems installed in areas affected by the Contract Works. Any fault or interruption in the proper functioning of any of these services shall be immediately reported to the Employer.

B.6.12 Asbestos Materials

No asbestos materials shall be brought onto the site.

The Services Contractor shall act immediately on discovery of possible asbestos and shall await the Main Contractor's instructions before proceeding with any works in that area.

B.7 Energy Efficiency

B.7.1 General Requirements

This Section sets out minimum standards for energy efficiency. The Services Contractor shall exceed these standards where higher efficiency requirements are specified elsewhere in connection with this Project.

The installation, commissioning, and operation of the mechanical and electrical services shall be in accordance with the requirements of the Planning Regulations, the Building Regulations Approved Documents Part L and MEES (Minimum Energy Efficiency Standard) Regulation 2018. Approved Document L1 applies to Dwellings and Approved Document L2 applies to all buildings other than Dwellings.

The Contractor shall adhere to the requirements of The Domestic Building Services Compliance Guide 2013 (Building Regulations).

The Services Contractor shall ensure that all plant and equipment installed on this project meets or exceeds the energy efficiency requirements of the Building Regulations as appropriate. Gas fired boilers shall be fully condensing type with a SEDBUK Grade A rating.

B.7.2 Heating Systems Controls

For dwellings, the heating shall be time switched, zoned and provided with boiler and pump interlocks. Time switching shall be provided by 7-day programmer with two channels; one for day rooms and one for bedrooms, each channel being capable of providing at least 2 ON and 2 OFF programmes/day. In 1 and 2 bed flats a single channel programmer is acceptable. The zoning system shall allow the temperature in each room/space to be separately controlled. The boiler and pump interlocks shall automatically switch the boiler off when there is no heating load; the pump being subject to timed run-on operation to prevent the boiler overheating in accordance manufacturers requirements.

B.7.3 Domestic Hot Water Controls

For dwellings, where non-storage systems are specified no additional energy efficiency requirements apply. Where storage systems are specified to prevent excessive boiler firing the heat exchanger shall be sized in accordance with BS 1566, BS 3198, or BS EN 128907 and for the primary LPHW system to be pumped. The additional Guidance of GPG 302 shall be followed. The primary heating to the HWS heater shall be programmed by 24-hour timer with at least 2 ON and 2 OFF programmes/day. The heat input to the HWS heater shall be controlled by stored water thermostat arranged to close the heating valve or disconnect the electrify supply to the immersion heater when the design temperature is reached. The stored water temperature shall be set at 60degC.

B.7.4 Limiting Heat Loss from LPHW Heating, Domestic Hot Water Services and Ventilation Services

All hot pipework, ductwork used for conveyance of warm air, and storage vessels for heating and hot water services shall be insulated to meet or exceed BS 5422, other than where the heat emission from pipes has been designed as part of the controlled heating system.

B.7.5 Limiting Exposure to Solar Overheating

Measure to be taken to with respect to meeting the requirements of Part L2 to avoid Solar Over-Heating shall be specified elsewhere in the Main Contract details.

B.7.6 Provision of Energy Efficient Air Conditioning and Mechanical Ventilation

General provisions shall include:
Heat recovery devices on ventilation systems
Air Conditioning/Heat Pump compressors to have inverter drives
Fan and pump motors to be variable speed to match load

B.7.7 Provision of Energy Efficient Lighting Systems

Dwellings shall meet the requirements of Part L1 with regard to the number of rooms/locations where high efficiency lighting with a luminous efficacy of not less than 45 lumens/circuit-watt is provided with a minimum of 75% of all general luminaires being high efficiency fittings.

B.7.8 Installation of Energy Meters

B.7.8.1 Residential Projects

This section applies to all buildings that would normally be categorised under Approved Document Part L1 of the Building Regulations and includes dwelling houses, apartments/flats and houses of multiple occupancy. Electricity consumption data and primary heating fuel consumption data shall be displayed to the occupants by means of approved display devices in accordance with the requirements of the "Code for Sustainable Homes".

The monitoring and display system shall be the 6 channel energy display unit type Net Things Energy Manager as supplied by the Code Store and shall be suitable to display consumption of electricity and gas and shall also display energy generated by on-site renewable energy systems such as PV panels.

A separate independent display system shall be dedicated to each residential unit.

Each system shall comprise processing unit with Wifi, display unit with Wifi, current transformers to monitor electricity consumption for each incoming phase, current transformers to monitor electricity generation from PV panels, inputs for monitoring pulsed outputs from gas, water and solar thermal systems and all necessary interconnection cables and sensors as required for full operation.

B.7.9 Residential Projects – Home User Guide (Code for Sustainable Homes and BREEAM Standards)

The Services Contractor shall provide two complete sets of record documentation with respect to each residential unit which forms part of the development for the use of the occupier and the owner to meet the requirements of the Sustainable Homes Code 4 – Home User Guide as specified under Section I.

This information shall be contained within the Services Contractors Abbreviated Operating and Maintenance Manual (see Section I).

The following information shall be provided:

a) Environmental Strategy/Design and Features

This section shall be submitted by the Designer for incorporation into the Home User Guide. (the Designer is the Services Consultant except in the case of Performance Specifications in which case the Designer is the Services Contractor).

This section shall provide – details of any specific environmental/energy design strategy/features including an overview of the reasons for their use (e.g. environmental and economic savings and restrictions on making alterations) and how they should best be operated (where they are not passive features such as insulations and SUDS). Strategies/features shall include such features as passive solar design, super insulation, energy efficient timber windows, heat recovery systems, photovoltaic panel, passive vents, or the use of certified timber or SUDS within the boundary of individual properties. (Each dwelling shall in any case be issued with a copy of the Code Certificate.)

b) Energy

This section shall be completed by the Services Contractor.

This section shall provide –

Description of the services installations, safe and efficient operation of the various systems, recommended actions to achieve best efficiencies, actions/methods of operation to be avoided, the requirements for maintenance and servicing and benefits of same on efficiency and reliability, and general advice to ensure the building can be operated in such a manner as to use no more fuel and power than is reasonable in the circumstances.

Information shall be provided on seasonal efficiency which shall include advice on seasonal adjustments, thermostat settings, control system settings and time switch settings.

Full information shall be provided on how renewable systems work and how they should be operated. Where ever possible such systems shall be provided with automatic controls commissioned to achieve optimum efficiency but advice shall be provided on the use of override controls in the event of system faults.

Instructions shall be provided on temporary action to be taken in the event of gas supply, water supply and power supply failure.

Advice shall be provided on the use of low energy lamps and recommended lamp replacements for fittings installed as part of the development works, to ensure and to maintain maximum energy efficiency. Information shall be provided to explain and compare the efficiency and operating cost of various lamp types including standard GLS tungsten, Low Voltage Halogen, Fluorescent, and LED types.

Advice shall be provided on the relative efficiency of white goods with an explanation of the Energy Rating System.

c) Water Use

Information shall be provided on measures incorporated into the installation regarding water efficiency. Details shall be provided where water flow restrictors have been incorporated into taps and shower valves and advice shall be provided advising against modification of taps and valves including the removal or replacement of these restrictors to increase flow rates.

Information shall be provided where water saving measures are provided such as rainwater butts and rainwater harvesting systems. In the case of active systems such as rainwater harvesting, detailed information shall be provided to explain how this works, what the harvested rainwater is used for, what action should be taken during times of low/nil rainfall, and what routine maintenance is to be undertaken.

SECTION C CRITERIA FOR DESIGN, TESTING & COMMISSIONING

C.1 GENERAL

C.2 LIGHTING PROVISION

C.3 SMALL POWER PROVISION

C.4 BUILDING THERMAL PROPERTIES

C.5 NATURAL INFILTRATION/VENTILATION RATES

C.6 DESIGN TEMPERATURES

C.7 DESIGN HUMIDITY LEVELS

C.8 DESIGN NOISE LEVELS

C.9 MECHANICAL EXTRACT VENTILATION RATES

C.11 DOMESTIC COLD WATER STORAGE

C.12 DOMESTIC HOT WATER STORAGE

C.13 DOMESTIC HOT WATER HEAT INPUT

C.14 DENSITY OF OCCUPATION

C.15 VENTILATION AIR FLOW DESIGN

C.16 WATER AND GAS PIPEWORK DESIGN

C.17 SOIL WASTE AND DRAINAGE DESIGN

C.18 DEMAND DIVERSITY & DESIGN REDUNDANCY

C.19 OPERATING PARAMETERS

C.20 TEST PRESSURES

C.1 GENERAL

Where this Specification is a Detailed Design Specification, the Services Contractor shall adhere to the following requirements for the installation and commissioning of the engineering services.

Where this Specification is a Performance Specification, the Services Contractor shall adhere to the following requirements for the design, installation and commissioning of the engineering services.

On completion of the installation, the Services Contractor shall demonstrate to the Engineer that the systems operate in accordance with these requirements.

The following design and test requirements shall be to be a minimum provision and shall be adjusted as necessary to suit application and to meet other Regulations.

C.2 LIGHTING PROVISION

C.2.1 Internal Lighting

All interior lighting shall be low energy with an installed efficiency of at least 45 lumens/W unless otherwise specified.

Lighting in private residential environments shall generally be in accordance with the CIBSE Code for Interior Lighting but actual illuminance levels shall be defined by the interior design requirements. Generally all fixed luminaires shall be low energy type with a light output of at least 40lumens/W.

C.2.2 External Lighting

The average lighting illuminance shall be in accordance with the recommendations of the Secured by Design Guide.

C.2.3 Means of Escape Lighting

Means of Escape Lighting shall comply with BS 5266.

The minimum illuminance provided by emergency means of escape luminaries throughout all means of escape routes when operating on battery/emergency electrical supplies shall not be less than 1.0 lux measured at floor level.

C.2.4 Lighting Circuit Provision

Unless otherwise specified, the minimum number of separately fused lighting circuits for a dwelling shall be as follows:
1 No. to serve Bedrooms, Bathrooms and associated Circulation up to floor area of 150m2
1 No. to serve Living Rooms, Kitchen, Utility, WC/Cloakroom and associated Circulation up to area of 150m2
1 No. to serve Garage/External

C.3 SMALL POWER PROVISION

C.3.1 General

Small power provision shall be in accordance with BS 7671.

Ring Main circuits shall be wired in cable of minimum size 2.5mm2 + 1.5mm2 CPC and be protected by 32A MCB + 30mmA RCD or by 32A 30mmA RCBO device and one Ring circuit shall serve an area not exceeding 50m2.

Radial circuits shall be wired in cable of minimum size 4.0 mm2 + 1.5mm2 CPC and be protected by 32A MCB + 30mmA RCD or by 32A 30mmA RCBO device and one Radial circuit shall serve an area not exceeding 20m2.

C.3.2 Commercial

Not Applicable

C.3.3 Residential

Unless otherwise specified, the minimum number of small power circuits shall be as follows:

1 No. Kitchen
1 No. Utility
1 No. Bedrooms and associated Circulation up to floor area of 100m2
1 No. Living Rooms and associated Circulation up to floor area of 100m2
1 No. Garage/External

Unless otherwise specified, the minimum number of socket outlets and fused spur connection points shall be as follows:

Bedrooms - A minimum provision of 3 No. switched double socket outlets (SDSO) shall be provided in each room with an additional 1 No. SDSO for each 5m2 area over 15m2.

Living Rooms - A minimum provision of 4 No. SDSO shall be provided in each room with an additional 1 No. SDSO for each 5m2 area over 15m2.

Kitchen - A minimum provision of 1 No. small power outlet (SDSO or switched fused spur as appropriate) shall be provided at each appliance position, 1 No. cooker control outlet for each hob and each oven and a minimum of 3 SDSO over worktop and 1 No. SDSO at low level shall be provided in each room with an additional 2 No. SDSO (1 No. over worktop and one at low level) for each 5m2 area over 15m2.

Utility - A minimum provision of 1 No. small power outlet (SDSO or switched fused spur as appropriate) shall be provided at each appliance position and a minimum of 2 SDSO over worktop and 1 No. SDSO at low level shall be provided in each room with an additional 2 No. SDSO (1 No. over worktop and one at low level) for each 5m2 area over 15m2.

Bath/Shower Rooms - 1 No. switched fused spur/flex outlet as appropriate) shall be provided at each appliance position.

Minimum of 2 No. surface metal clad switched double socket outlets shall be provided in each garages, each plant rooms and each areas designated for storage and/or workshop purposes.

Provision to be increased as appropriate to size and function of space.

C.4 BUILDING THERMAL PROPERTIES

The thermal insulation properties of the building shall comply with or exceed the requirements of the current Building Regulations.

The Services Contractor shall obtain specification details of walls, roofs, floors and glazing from the Architect.

Where underfloor heating is provided as the primary means to achieve the design internal temperature, the maximum insulating effect of the carpet and underlay combined shall not exceed a TOG rating of more than 1.5.

C.5 NATURAL INFILTRATION/VENTILATION RATES

Naturally Ventilated Spaces:
This shall not exceed 0.5 air changes/hour.

Mechanically Ventilated Spaces (where balanced Supply and Extract ventilation is provided):
This shall not exceed 0.5 air changes/hour

Mechanical Extract to Toilets:
Where no mechanical supply air is provided and replacement air is by Natural means, internal access doors to the toilets shall be undercut by 10mm subject to Building Control approval.

C.6 DESIGN TEMPERATURES

The following conditions are used as the basis of the design:

C.6.1 External Design Conditions:

Winter Design:	-3°C
Summer Design:	28°C Dry Bulb & 21°C Wet Bulb
Entrance/Lobby:	16°C
Reception:	22°C
Waiting Rooms:	22°C
Private Offices:	22°C
General Office Areas:	22°C
Meeting Rooms/Libraries:	22°C
Toilets/Changing Rooms:	23°C
Circulation:	18°C
Commercial Kitchens:	18°C
Swimming Pool Hall:	29°C
Plant Rooms:	10°C Minimum

D.6.2 Internal Summer Design Conditions (Applies to areas with Comfort Cooling/Air Conditioning):

Not Applicable

C.7 DESIGN HUMIDITY LEVELS

Not Applicable

C.8 DESIGN NOISE LEVELS

C.8.1 Internal

The following noise levels shall not be exceeded as the result of noise emanating from the mechanical services installation:

Entrance/Lobby:	NR45
Reception:	NR40
Waiting Rooms:	NR35
Private Offices:	NR30
Meeting Rooms/Libraries:	NR35
General Office Areas:	NR40
Toilets/Changing Rooms:	NR45
Circulation:	NR40
Commercial Kitchens:	NR55
Swimming Pool Hall:	NR40
Plant Rooms:	NR60
Elsewhere:	NR45

C.8.2 External

External noise levels shall be in accordance with the Local Authority/Environmental Health Officer's requirements.

External noise levels resulting from the operation of the mechanical services systems shall not cause the noise levels within the building to exceed the criteria stated in C.8.1.

Office Areas:	Equal to Mechanical Supply Rate
Toilet & Changing Rooms:	8 Air Changes/Hour
Internal Corridors:	2 Air Changes/Hour

Where only extract ventilation is provided and fresh air make up is achieved by natural infiltration, the design of the extract ventilation shall be to the following minimum standards:

Commercial Applications

Toilet Extract:	8 Air Changes/Hour
Internal Corridors:	2 Air Changes/Hour
Kitchen:	30-50 Air Changes/Hour

D.10 MECHANICAL FRESH AIR SUPPLY VENTILATION RATES

Where mechanical supply and extract ventilation is provided, the design of the supply ventilation shall be to the following minimum standards:

Commercial Applications

Office Area:	12 l/sec per Person
Toilets:	75% of Extract Rate - balance by infiltration
Internal Corridors:	Equal to Mechanical Extract Rate

D.11 DOMESTIC COLD WATER STORAGE

Not Applicable

D.12 DOMESTIC HOT WATER STORAGE

Not applicable

D.13 DOMESTIC HOT WATER BOILER POWER

Commercial Offices: 0.12 kW/person

D.14 DENSITY OF OCCUPATION

In the absence of specific guidance from the Employer, the following average levels of occupation of the building are to be assumed as the basis for the design:

Commercial Office Space: 1 Person/10 m² of the Net Internal Office Area

D.15 VENTILATION AIR FLOW DESIGN

D.15.1 General

The following design criteria are maximum permissible values. The Design Contractor shall reduce these values as necessary to suit application and to meet the requirements other design criteria.

D.15.2 Air Velocity and Pressure Drop Limitations in Low Velocity Ventilation Ducts

The maximum permitted velocity in final branch ducts (air flow rate 10 to 200 l/sec) shall be 2.5 m/s
The maximum permitted velocity for air flow rate 100 to 300 l/sec shall be 3.0 m/sec
The maximum permitted velocity for air flow rate 300 to 500 l/sec shall be 4.0 m/sec
The maximum permitted velocity for air flow rate 500 to 1000 l/sec shall be 5.0 m/sec
The maximum permitted velocity for air flow rate 1000 to 3000 l/sec shall be 6.0 m/sec
The maximum permitted velocity for air flow rate 3000 l/sec and over shall be 7.0 m/sec

Ducts in riser shafts may be sized with velocities 25% greater than above.

The Pressure Drop shall not exceed 1.75 N/m2 per 1.0m of straight duct run.

D.15.3 Air Velocity Limitations in High Velocity Ventilation Ducts

The maximum permitted velocity in final branch ducts sizes up to 200mm dia shall be 7.5 m/s
The maxim permitted velocity for duct sizes up to 300mm dia shall be 10.0 m/sec
The maximum permitted velocity for duct sizes 300mm to 600mm dia shall be 12.5 m/sec
The maximum permitted velocity for duct sizes over 600mm dia shall be 15.0 m/sec

Ducts in riser shafts may be sized with velocities 25% greater than above.

The Pressure Drop shall not exceed 30 N/m2 per 1.0m of straight duct run.

D.15.4 Air Velocity Limitations at Grilles, Diffusers and Louvres

The maximum velocity at the face of grilles diffusers and louvres shall be determined by application taking into account the requirements for noise levels, temperature control and comfort.

Supply and extract open-ended stub ducts above ceilings shall be limited to air velocity of 2.5 m/sec at the opening.

Supply grilles and diffusers shall be designed to achieve a maximum in-space air velocity of 0.5 m/sec when measured at a distance of 1.0m from the grille or diffuser within the conditioned space (to be 2.1m from floor level).

Extract grilles shall have a maximum face velocity of 5.0 m/sec and a maximum velocity based on free area of 3.5 m/sec.

Intake and exhaust louvres (weather louvres) shall have a maximum face velocity of 8.0 m/sec with a maximum velocity based on free area of 5.0 m/sec.

D.16 WATER AND GAS PIPEWORK DESIGN

D.16.1 General

The following design criteria are maximum permissible values. These values shall be reduced as necessary to suit application and to meet the requirements other design criteria.

D.16.2 Hot and Cold Water Pipework Services Velocity and Pressure Drop Limitations

The maximum permissible velocity shall be 1.5 m/sec

The maximum permissible pressure drop shall be 300 Pa per 1.0 m.

Domestic hot and cold pipework shall be sized to ensure that a dynamic pressure of at least 1.0 bar is available at every final connection to sanitary ware and appliances. A water booster shall be provided if the design pressures and flow rates cannot be achieved by either gravity or by direct mains water connection.

D.16.3 Gas Pipework Services Velocity and Pressure Limitations

The maximum permissible velocity shall be 5 m/sec

The maximum permissible pressure drop shall be 3.0 Pa/m

The maximum allowable dynamic pressure drop at maximum flow measured between meter position and each appliance shall not exceed 1.0 mbar (100 Pa).

D.17 SOIL, WASTE AND DRAINAGE DESIGN

Wherever possible drainage shall be designed to ensure all drainage runs to sewers by gravitational method. Where pumping is unavoidable, foul and surface water systems shall be designed to minimise the volume of drain to be pumped by separating the services to permit the maximum drain volume by gravitational method.

The following design criteria are maximum permissible values. The Design Contractor shall reduce these values as necessary to suit application and to meet the requirements other design criteria.

Waste Branches

Minimum Fall shall be: 1^{O} or 18mm/1000mm or 1/55
Maximum Fall shall be: 2.5^{O} or 45mm/1000mm or 1/22

WC Branches

Minimum Fall shall be: 0.5^{O} or 9mm/1000mm or 1/111
Maximum Fall shall be: 5^{O} or 90mm/1000mm or 1/11

Foul Drain

Minimum fall for 100 dia Drain shall be: 1/40 (reduced fall possible subject to approval depending upon application)
Minimum fall for 150 dia Drain shall be: 1/60 (reduced fall possible subject to approval depending upon application)

Surface Water Drain

Minimum fall for 100 dia Drain shall be: 1/80 (1/100 possible subject to approval depending upon application)

D.18 DEMAND DIVERSITY & DESIGN REDUNDANCY

D.18.1 Central Boiler Plant

Where a boiler serves a single building with a single user, the plant sizing shall be as follows:

Single duty boiler:	Output shall be 100% of design loading (No Redundancy)
2 duty boilers:	Total output shall be 133% of design loading (33% Redundancy)
3 or more duty boilers:	Total output shall be 100% of design loading (No Redundancy)

Where a central boiler serves a number of buildings or user areas or a number of dwellings (multi-residential) the boiler sizing shall be as follows:

Schools/Public Buildings: Shall be as D.18.1

D.18.2 Central Water Chiller/Refrigeration Plant

Not Applicable

D.18.3 Heat Recovery Heating & Cooling Systems

Not Applicable

D.18.4 Domestic Hot and Cold Water

Pipework shall be sized on the basis of peak diversified flow rates calculated using CIBSE Demand Unit Method, BS EN 806 or Institute of Plumbing Loading Units method.

Where a water booster set is required to achieve the design system flow rates and pressures, this shall be sized to meet the diversified design flow rates with at least 33% redundancy capacity provided by means of standby equipment.

D.18.5 Sanitation and Drainage Services

Pipework shall be sized to meet the diversified flow rates as calculated in accordance with the Institute of Plumbing "Plumbing Engineering Services Design Guide".

D.19 OPERATING PARAMETERS

Boiler Flow Temperature:	80°C
Boiler Return Temperature:	60°C (unless otherwise specified)
Boiler System Pressure:	Max of 1.0 bar at highest point in system - system at ambient temperature
HWS Storage Temperature:	Minimum of 55°C and Maximum of 60°C
HWS Return Water Temperature:	50°C
HWS Draw-Off Temperature:	50°C to be reached within 30 seconds of opening tap unless TBVs fitted
HWS Draw-Off Temperature (TBV):	Set Point of TBV to be reached within 30 seconds of opening tap
H&C Water Boosting Pressures:	1.0 bar at highest draw-off point

D.20 TEST PRESSURES

Heating and Chilled Water Systems:	Cold Water Pressure Test to 200% x Working Pressure or 5 bar whichever is higher for 2 hour duration
Un-boosted Domestic Water Systems:	Cold Water Pressure Test to 5 bar for 2 hour duration
Boosted Domestic Water Systems:	Cold Water Pressure Test to 200% x Pump Closed Head Pressure or 10 bar whichever is the higher for 2 hour duration
Sanitary Pipework:	Air Pressure Test of 40mm water gauge positive pressure for 5 minute duration
Drainage:	Cold Water Pressure Test of 1.5m static head above invert level of head of drain for 2 hour duration

SECTION D STANDARD SPECIFICATION – DRAINAGE, SANITATION, PLUMBING & RAINWATER DISPOSAL SERVICES

D.1 DRAINAGE SERVICES

D.1.1 Scope of Work

Drainage services include the installation of foul and waste water drain pipework and fittings including manhole and inspection chambers within the building and external to the building. This includes buried and suspended drains.

Where gullies, manhole/inspection chamber covers and rainwater goods are specified these are subject to confirmation by the Architect.

D.1.2 General

Wherever possible drainage shall be designed to ensure all drainage runs to sewers by gravitational method.

Where pumping is unavoidable, foul and surface water systems shall be designed to minimise the volume of drain to be pumped by separating the services to permit the maximum drain volume by gravitational method.

D.1.3 Setting Out

The Contractor shall include for true and proper setting out of the contract works. The setting out shall be carried out by experienced operatives with the appropriate equipment. All measurements shall be taken from site measurements whenever possible. Drawings shall not be scaled. All setting out dimensions shall be confirmed by the Architect prior to installation.

The Contractor shall ensure the correct positioning, depth, alignment and gradients of all pipework, manholes/inspection chambers, and equipment.

Where a pipe gradient is specified, the Contractor shall ensure this gradient is maintained as a constant throughout the complete run of pipe.

Where levels are specified the Contractor shall ensure that the installation complies with these with a maximum tolerance of +/- 5mm.

Where a pipe gradient is specified, the Contractor shall ensure this gradient is maintained constant throughout the complete run of pipe with a maximum tolerance of +/- 0.5%.

The installation of pipes and equipment shall be correctly located in relation to the structure of buildings and any special features or fittings attached to it. The position of drain connections for stub stacks, soil vent pipes (SVPs) and direct connections to WCs etc shall be confirmed by the Architect prior to installation

The Contractor shall comply with the manufacturers' information and recommendations with regard to installation and future maintenance of items of equipment.

D.1.4 Access

Access for inspection, clearance and cleaning and maintenance shall be provided to the drainage system as Building Regulations Part H and BS EN 752.

The maximum distance between access points shall be 22m.

D.1.5 Protection, Bedding and Backfilling

Where drain pipes pass through foundations and structural walls, the pipe shall be protected from the risk of imposed stress by provision of a suitable beam, lintel or by formation of structural arch in accordance with the Structural Engineers instructions.

Bedding and backfilling shall be in accordance with Part H of the Building Regulations and BS EN 752 and the loading shall be assumed as being for "Light Traffic" standards in all areas where there is to be a hard landscape finish (drive, car parking etc) unless otherwise specified.

Where reduced cover over drainpipes is unavoidable special protection measures shall be adopted as Part H of the Building Regulations.

Where external drainpipes are located 1.0m or less from the building special measures as Part H of the Building Regulations shall be adopted to protect the pipe.

D.1.6 Testing

The complete plumbing and drainage system shall be tested to the complete satisfaction and in the presence of the Local Authority Environmental Health Inspector.

The complete pipework drainage system shall be tested in accordance with Part H of the Building Regulations.

The system shall be subject to a water test with a positive pressure of at least 1.5m head measured from invert at highest point of drain and applied for at least 2 hours during which time the water loss shall not exceed the stated requirements. Sectional testing shall be undertaken to ensure the applied test pressure shall not exceed 4.0m head.

D.1.7 In-Ground & Suspended Drainage Pipes & Fittings

All drain pipework shall be cast iron pipe and joints as Sinclair Ensign to BS 437 with flexible joints to BS EN 877.

Pipework shall be installed in strict accordance with the manufacturers' recommendations especially with regard to jointing and the support of horizontal pipework.

Sufficient access doors shall be located in the pipework to enable the clearing and maintenance of the system in accordance with BS EN 12056.

Connections to the underground drainage system shall be by fittings manufactured especially for that purpose and shall incorporate transitional couplings.

Pipes shall be installed plumb and vertical or to even falls as required by British Standards.

Unless specified otherwise, foul water drain pipes of size 100mm shall be laid to falls of 1:40 and drain pipes of size 150mm shall be laid to falls of 1:60. Unless specified otherwise, surface water drain pipes shall be laid to falls of 1:80 or greater.

Bends shall be of large radius.

D.1.8 Manholes and Inspection Chambers

Manholes/Inspection Chambers shall be provided as indicated on the drawings, in accordance with Part H of the Building Regulations and BS EN 752.

Manholes/Inspection chambers shall be constructed from engineering bricks to BS EN 771 & 772, concrete blocks to BS EN 771 & 772, or precast concrete to BS 5911.

Manholes and Inspection Chambers shall be to the following minimum sizes:

Access Fittings

Up to 0.60m deep:	225 x 100 or 225 dia.
Cover Size:	225 x 100 or 225 dia.

NOTE: Max depth of 0.60m applies except where Access Fitting is installed within a chamber

Inspection Chambers (Maximum drain pipe size 150mm)

Up to 0.60m deep:	225 x 100 or 225 dia.
Cover Size:	225 x 100 or 225 dia.
Up to 1.20m deep:	450 x 450 or 450 dia.
Cover Size:	430 x 430 or 430 dia.

Manholes (Sizes for maximum drain pipe size 150mm)

Up to 1.0m deep:	750 x 675 or 1000 dia.
Cover Size:	750 x 675
1.0m to 1.5m deep:	750 x 675 or 1000 dia. with steps
Cover Size:	750 x 675
1.5m to 3.0m deep:	1200 x 1000 or 1200 dia. with steps
Cover Size:	Minimum size 600 x 600 or 600 dia.

Manhole/Inspection Chamber sizes shall be increased as necessary to accommodate the required connection arrangement. Manholes with connections both sides shall be minimum width of 750mm.

Double steps to BS EN 1247 shall be provided where manhole depth is 1.0m and greater. Top step shall be a maximum of 675mm from surface level.

Generally construction shall employ use of half-round open channels with a design fall of 1 in 40 though the chamber. Benching and render details and materials shall be in accordance with BS EN 752.

D.1.9 Manhole Covers and Inspection Chamber Covers

Manhole covers shall be to BS EN 124 with non-ferrous hold down bolts and fitted with seal. Internal manholes shall be provided with double seal covers.

Covers in roadways and areas of vehicle access shall be heavy Class D 400 suitable for heavy traffic. Elsewhere covers shall be medium weight steel Class B 125 suitable for pedestrian and light traffic.

The cover design shall be confirmed by the Architect and shall be suitable for the location and specification for finishes.

Where specified covers shall be recessed dished type to accept hard landscaping finish such as stone slabs or cobbles.

D.1.10 Gullies, Traps and Outlets

Plant room, and general internal wash-down gullies shall be 100mm trapped gully as Saint Gobain type Gullytrap TD551 with sediment pan with TD 650 grating and TD 678 raising piece. The Contractor is to select from the available TD 678 raising piece options to achieve the required drain invert and grating levels.

Yard gullies where providing surface water drainage shall be 100mm trapless gully as Saint Gobain type Gully TD556 with sediment pan with TD 651 heavy-duty grating and TD 678 raising piece. The Contractor is to select from the available TD 678 raising piece options to achieve the required drain invert and grating levels.

Where the shower waste is to have direct connection to drain, the Wade International 100mm GP 1104 top-accessible shower trap shall be provided with Wade K2307 s/s circular grating (176 dia.) with 100mm side outlet discharge connection to drain. The Architect is to confirm the specification for grating.

D.1.11 Verification of Levels

Immediately upon the installation of drainage services, the Contactor shall engage a survey specialist to verify the installed invert and cover levels of all inspection chambers, manholes, and pumping chambers, and the invert levels of all drain and ventilation pipe connections to inspection chambers, manholes and pumping chambers.

The Contractor shall compile and issue for the Engineer's comment, a survey report which shall include all measured levels with a scaled plan of the installation which shall include details of all pipe sizes, and chamber references.

D.2 RAINWATER DISPOSAL

D.2.1 Scope of Work

This section includes:

- Roof gullies
- Rainwater down pipes from the point of connection to gutters and roof gullies/outlets
- Rainwater disposal

The specification and detailing of gutters, hoppers, roof coverings and water proofing/sealing shall be specified by the Architect.

D.2.2 General

Wherever possible drainage shall be designed to ensure all drainage runs to sewers by gravitational method.

Where pumping is unavoidable, surface water systems shall be designed to minimise the volume of drain to be pumped by separating the services to permit the maximum drain volume by gravitational method.

All visible elements of the installation such as down pipes and gullies shall be as specified by the Architect. This includes location, material, appearance and finish. The Contractor shall not proceed with any of these works without being in receipt of a full design requirements issued under Architects Instruction.

The location of external rainwater pipes may be required to coordinate with and/or conceal other services such as lightning protection tapes. In such circumstances the Contractor shall ensure that the installation is programmed to enable the correct sequence of working to be adopted.

The installation of all visible elements of the installation shall be installed and fixed to achieve a high quality of appearance with all pipes positioned vertically in all planes and brackets shall be located at regular intervals and fixed perpendicular to the pipes. Pipe brackets shall be matched to the type and size of pipe. All fixings shall be suitable for external use and screw and bolts shall be stainless steel.

On completion the Contractor shall provide a suitable paint finish to all external elements of the installation other than self-finished plastic components.

D.2.3 Setting Out

The Contractor shall include for true and proper setting out of the contract works. The setting out shall be carried out by experienced operatives with the appropriate equipment.

The Contractor shall ensure the correct positioning, depth, alignment and gradients of all pipework, and equipment. The Contractor shall comply with the manufacturers' information and recommendations with regard to installation and future maintenance of items of equipment.

Where a pipe gradient is specified, the Contractor shall ensure this gradient is maintained constant throughout the complete run of pipe.

Where levels are specified the Contractor shall ensure that the installation complies with these with a maximum tolerance of +/- 5mm.

Where a pipe gradient is specified, the Contractor shall ensure this gradient is maintained constant throughout the complete run of pipe with a maximum tolerance of +/- 0.5%.

The installation of pipes and equipment shall be correctly located in relation to the structure of buildings and any special features or fittings attached to it.

All measurements shall be taken from site measurements whenever possible. Drawings shall not be scaled. All setting out dimensions shall be confirmed by the Architect prior to installation.

D.2.4 Access

Access for inspection, clearance and cleaning and maintenance shall be provided as Building Regulations Part H and BS EN 752.

D.2.5 Protection and Fire Rating

Where internal rainwater pipework pass through structural walls and floors, the pipes shall be protected from the risk of imposed stress by provision of a suitable steel sleeve. In addition, in the case of large pipes lintels or similar protection shall be provided in accordance with the Structural Engineers instructions.

Where internal PVC rainwater pipework passes through fire rated walls and floors, the pipes shall be fitted with suitably rated proprietary fire sleeves which shall be installed in accordance with the manufacturer's recommendations and Part B of the Building Regulations.

D.2.6 Testing

The complete plumbing and drainage system shall be tested to complete satisfaction and in the presence of the Local Authority Public Health Inspector and in accordance with Part H of the Building regulations.

D.2.7 Gutters and Roof Gullies

Gutters shall be as detailed on the Architects drawings. Gutters shall be laid to falls as specified by the Architect.

The Contractor shall connect rainwater down pipes to gutters as detailed by on the Architects drawings. The method of connection shall be specified by the Architect

Rainwater roof outlets and gullies shall be as specified by the Architect. Installation of roof outlets and gullies shall be in accordance with the Architects details especially with regard to maintenance of roof covering and water sealing.

Roof gullies shall be thermally insulated within roof voids to prevent condensation.

D.2.8 Rainwater Down Pipes

Rainwater down pipes shall be located and as detailed on the Architects drawings and shall be aluminium to BS 8530, cast iron to BS 460 or UPVC to BS EN 12200.

All pipework, pipework fittings, brackets and fixings shall be supplied by the specified supplier and shall be from the same range of goods.

A sufficient number of brackets shall be provided to ensure the pipework installation is stable and

Internal rainwater pipes shall be thermally insulated within the building to prevent condensation.

D.2.9 Connection to Drains

Rainwater down pipes shall not be connected to foul drain systems unless this is specifically specified.

Where specified the rainwater shall be discharged to rainwater/surface water drains, soakaways or other method of disposal.

Generally rainwater drains shall not be trapped except where discharging directly to foul or combined drains in which case a suitable trap must be incorporated prior to the connection to the drain.

Where rainwater pipes are specified as discharging to the foul or combined drain systems, connection shall only be made at specified manhole/inspection chamber locations.

D.3 SOIL & WASTE WATER SERVICES

D.3.1 Scope of Work

Soil and Waste Water services shall include the installation of soil vent pipes, stub stacks, soil and wastewater branches, and overflow pipework and fittings.

Where traps and sanitary ware fittings are specified these are subject to confirmation by the Architect.

D.3.2 General

Wherever possible drainage shall be designed to ensure all drainage runs to sewers by gravitational method.

Where pumping is unavoidable, foul water systems shall be designed to minimise the volume of drain to be pumped by separating the services to permit the maximum drain volume by gravitational method.

D.3.3 Setting Out

The Contractor shall include for true and proper setting out of the contract works. The setting out shall be carried out by experienced operatives with the appropriate equipment.

The Contractor shall ensure the correct positioning, depth, alignment and gradients of all pipework, and equipment. The Contractor shall comply with manufacturers' information and recommendations with regard to installation and future maintenance of items of equipment.

Where a pipe gradient is specified, the Contractor shall ensure this gradient is maintained constant throughout the complete run of pipe.

Where levels are specified the Contractor shall ensure that the installation complies with these with a maximum tolerance of +/- 5mm.

Where a pipe gradient is specified, the Contractor shall ensure this gradient is maintained constant throughout the complete run of pipe with a maximum tolerance of +/- 0.5%.

The installation of pipes and equipment shall be correctly located in relation to the structure of buildings and any special features or fittings attached to it. The position of drain connections for stub stacks, SVPs and direct connections to WCs etc shall be confirmed by the Architect prior to installation

All measurements shall be taken from site measurements whenever possible. Drawings shall not be scaled. All setting out dimensions shall be confirmed by the Architect prior to installation.

D.3.4 Access

Access for inspection, clearance and cleaning and maintenance shall be provided as Building Regulations Part H and BS EN 752.

Access positions shall be provided in all soil vent stacks immediately above the point of connection to drains, at every 45deg and 90deg bend and elsewhere as appropriate. Rodding eye positions shall be provided on waste pipework at as near to positions of connection to sanitary equipment and kitchen/laundry appliances as practical.

D.3.5 Protection and Fire Rating

Where soil and waste pipework pass through structural walls and floors, the pipes shall be protected from the risk of imposed stress by provision of a suitable steel sleeve. In addition, in the case of large pipes lintels or similar protection shall be provided in accordance with the Structural Engineers instructions.

Where PVC soil and waste water pipework passes through fire rated walls and floors, the pipes shall be fitted with suitably rated proprietary fire sleeves which shall be installed in accordance with the manufacturer's recommendations and Part B of the Building Regulations.

D.3.6 Testing

The complete plumbing and drainage system shall be tested to complete satisfaction and in the presence of the Local Authority Public Health Inspector and in accordance with Part H of the Building regulations.

The above ground system shall be air tested to a pressure of 38mm water gauge and shall remain constant for a period of 3 minutes as described in BS EN12056.

D.3.7 Soil, Waste and Ventilation Stacks

All soil waste and ventilation stacks shall be in cast iron and shall conform to BS 4514 and BS EN 1329.

Pipework shall be installed in strict accordance with the manufacturers' recommendations especially with regard to the making of joints and the support of horizontal pipework.

Sufficient access doors shall be located in the pipework to enable the simple clearing and maintenance of the system in accordance with BS EN 12056.

Connections to the underground drainage system shall be by fittings manufactured especially for that purpose and shall incorporate an "O" ring joint for expansion.

Pipes will be installed plumb and vertical or to even falls as required by British Standards.

Bends where possible shall be of large radius.

D.3.8 Branch Waste and Anti-Siphon Pipework

All branch waste and anti-syphonage pipework shall be in grey MUPVC and shall comply with BS 5255 and BS EN 1329.

Branch pipework shall be acoustically insulated in Rockwool Techwrap 2.

The jointing method shall be solvent welding using the manufacturers approved cement. Seal ring joints shall be introduced where it is necessary to accommodate expansion.

Long sweep fittings shall be used wherever possible and they shall be similar to those manufactured by Terrain Ltd. The installation shall be in strict accordance with the manufacturers' recommendations especially with regard to the making of the joint and the provision of expansion joints.

Sufficient rodding eyes and clean outs shall be located in the pipework to enable the simple clearing and maintenance of the system. The location of access points shall be in accordance with BS EN 12056.

Branch anti-syphonage pipes shall be run above the flood level of the fitment they serve and where connected to the main vent pipe shall do so above the spill-over level of the highest appliance.

Where prefabricated pipework is specified it shall be in copper tube to BS 1057 R250 and shall be manufactured by reputable company, which specializes in the manufacture of such units (e.g. Econa Ltd. or Dreh Patents Ltd.). The unit shall incorporate all necessary sweeps in the direction of the flow.

Alternatively prefabricated UPVC pipe and fittings to BS 3505, BS 5255 and BS EN 1329 may be used provided that they are manufactured by a reputable company specializing in the manufacture of such units (e.g. Caradon, Terrain).

Traps to sanitary ware shall be of deep seal pattern manufactured from molded white polypropylene and shall have a universal compression outlet and shall comply with BS EN 274. Where un-vented ranges of pipework are required anti-siphon type bottle traps shall be employed where necessary.

D.3.9 WC Overflows

The WC overflows shall be in MUPVC and shall comply to B.S. 5255 and BS EN 1329 with solvent weld jointed fittings. Connections to bath overflow fittings shall be made through a proprietary coupling.

The pipework shall be adequately supported throughout with UPVC clips or brackets.

D.3.10 Pipe Supports

All pipework shall be adequately supported and in no case shall distance between the supports exceed those given in the following tables.

MUPVC Pipe	Horizontal	Vertical
32mm	500mm	1,200mm
40mm	500mm	1,200mm
50mm	900mm	1,200mm
UPVC Pipe	Horizontal	Vertical
50mm	900mm	1,200mm
75mm	900mm	1,800mm
100mm	900mm	1,800mm
150mm	1,000mm	1,800mm

The brackets for fixing MUPVC pipework shall be manufactured from polypropylene and hose for fixing UPVC pipe shall be manufactured from steel with plastic coating.

D.3.11 Acoustic Treatment

Soil and vent stacks shall be acoustically clad by application of 25mm Acoustic insulation as Rockwool Techwrap2.

D.4 DOMESTIC HOT & COLD WATER PLUMBING SERVICES

D.4.1 Scope of Work

Domestic hot and cold water plumbing services includes the complete installation of pipework and equipment in connection with drinking/potable water supplies, cold water mains, cold water down services, and domestic hot water services including return/circulation pipework.

Specifications for items of equipment such as pipework and fittings, tanks, pumps, cylinders and thermal insulation are provided in Section F of the Specification

D.4.2 General

The installation of domestic hot and cold water services shall be in accordance with Part G of the Building Regulations, BS EN 806 and BS 8558.

The installation shall be in accordance with all relevant Water Regulations. In particular all fittings including taps, mixer valves/taps and shower fittings shall be WRAS approved.

The Services shall be installed to achieve adequate water discharge at all draw-off points.

D.4.3 Setting Out

The Contractor shall include for true and proper setting out of the contract works. The setting out shall be carried out by experienced operatives with the appropriate equipment.

The Contractor shall ensure the correct positioning, depth, alignment and gradients of all pipework, manholes/inspection chambers, and equipment. The Contractor shall comply with manufacturer's information and recommendations with regard to installation and future maintenance of items of equipment.

Where a pipe gradient is specified, the Contractor shall ensure this gradient is maintained constant throughout the complete run of pipe.

Pipework shall be graded such that air venting is naturally achieved at draw off points. Pipes shall not be installed such that unvented high points are created.

Pipework shall be graded to fall to drain down valves. Pipes shall not be installed such that sections of the installation cannot be drained.

The installation of pipes and equipment shall be correctly located in relation to the structure of buildings and any special features or fittings attached to it.

All measurements shall be taken from site measurements whenever possible. Drawings shall not be scaled. All setting out dimensions shall be confirmed by the Architect prior to installation.

D.4.4 Access

All valves, pumps, strainers and other fittings which require routine access shall be positioned to enable access for inspection, adjustment, servicing and replacement.

Where such equipment is positioned in ceiling and floor voids, access panels shall be provided.

D.4.5 Testing

Pressure testing shall be carried out as detailed in Section I of this Specification.

The Contractor shall undertake testing of the domestic water services at each Point of Use to determine maximum temperature achieved and time taken to reach design temperature. The results shall be scheduled and issued for approval.

D.4.6 Pipework and Fittings

Domestic water services shall be installed in copper tube to BS EN 1057 R250. The Contractor may install stainless steel tube and fittings in lieu of copper pipework subject to the prior approval of the Engineer. Stainless steel tube and compatible fittings shall be CrNiMo 316 to BS EN 10216.

The pipework shall be adequately supported throughout with stainless steel or non-ferrous supports, brackets or clips. The routing and supporting of pipes shall take into account, thermal movement and correct grading to permit both air venting and drainage.

Adequate drain down points shall be provided to permit the complete drainage of the system.

All valves and fittings shall be suitable for an 'open system' and shall be of copper or gunmetal construction and have the approval of the Water Supply Company.

Detailed specification requirements for pipework and fittings are provided in Section F of this Specification.

D.4.7 Thermal Insulation

Thermal insulation shall be in accordance with Part F of this Specification and Parts G and L of the Building Regulations.

D.4.8 Isolating Valves

Isolating valves shall be provided at all connections to all plant, equipment, cylinders/calorifiers, pumps, boilers, tanks, water treatment units, water boosting units, ball valves and control valves.

In addition isolating valves shall be provided on hot, cold and drinking water supplies serving each individual room.

Isolating valves shall be located in accessible positions and the locations shall be clearly identified on record drawings.

Isolating valves shall be as detailed in Section F of this Specification.

D.4.9 Drain Down Valves

Drain down valves shall be provided at all low points in the installation and adjacent to items of plant and equipment to allow removal without the need for a system drain down. In addition drain down valves shall be provided on all tanks and cylinders.

Drain down valves shall be located in accessible positions and the locations shall be clearly identified on record drawings.

Drain down valves shall not have lever or wheel head operation and shall be arranged such that operation is only possible with a specially designed key. Drain down valves shall be complete with hose union couplings.

Drain down valves shall be as detailed in Section F of this Specification.

D.4.10 Domestic Hot Water Circulation

Domestic hot water pipework systems shall be provided with either a pumped circulation return or with electric trace heating to ensure design temperatures are achieved at draw off points within 30 seconds.

Design temperature is 55 degC for systems without thermostatic blending valves at point of use and where thermostatic blending valves are installed the design temperature shall be the set point of the valve but shall not exceed 48 degC.

Long dead legs at final connections to sanitary ware and appliances shall be avoided unless provided with electric trace heating.

D.4.11 Domestic Hot water Blending Valves

Where specified and wherever required to comply with Part G3 of the Building Regulations, blending valves shall be installed at the point of use. Blending valves shall be direct acting thermostatic type designed to limit the supply temperature and may be either incorporated into the mixing tap or be a stand-alone valve to be installed close to the point of use.

Blending valves shall be as detailed under Section B of this Specification and as detailed on the Design Drawings.

D.4.12 Prevention of Legionnaires Disease

The installation shall be installed, sterilised, tested, operated and maintained in accordance with the requirements of ACOP L8 – The Control of Legionella Bacteria in Water Systems issued by HSC. There shall be a legionnaires cycle installed within the Hot Water Cylinder due to the ASHP installation.

D.4.13 Unvented Hot Water Systems

The installation shall be in accordance with requirements of Part G3 of the Building Regulations.

In particular the control and limitation of supply water temperature, the provision of over-pressure and over-temperature safety devices, provision of thermal expansion devises, and the requirements for the safe routing, discharge and termination of safety relief pipes shall be strictly in accordance with Part G3 of the Building Regulations.

D.4.14 Prevention of Scalding

All domestic hot water systems shall comply with Part G3 of the Building Regulations regarding prevention of scalding. Direct acting thermostatic blending valves shall be provided at point of use to limit supply water temperature to a maximum of 48degC.

The maximum supply temperature shall be reduced below 48degC. In the case of particular premises such as Care Homes in accordance with NHS Estates Model Specification D 08.

D.4.15 Exposed to View Final Connections

Final exposed to view pipework connection to sanitary appliances and kitchen/laundry equipment shall be run in polished chrome finished pipework with polished chrome fittings, brackets and fixings.

D.4.16 Connections to Sanitary Appliances and Kitchen/Laundry Equipment

All hot and cold final connections shall be fitted with approved ball type service valves as Ballofix with slot head or lever operation. Chrome finish to be used where exposed to view.

Final connections to dishwashers, glass-washers and clothes washing machines shall be fitted with double check valves.

Up-spray type bidets shall not be connected to the domestic hot and cold pipework systems. These appliances must be connected to a completely independent pipework system in accordance with Water Regulations.

D.4.17 External Water Supplies and Hose Connections

External buried potable water supplies, other than Supply Company services, shall be run in MDPE pipework, which shall be at a depth of at least 750mm.

External buried non-potable water supplies such as irrigation services and which are not connected to potable services, may be run in Black Polythene pipework which shall be at a depth of at least 600mm.

Connections to residential hose points shall be provided with isolation valves and double check valves. Hoses shall incorporate fail safe means of flow shut-off or if connected to sprinkler systems, the sprinkler heads shall be at least 150 above ground level.

Water supplies to seep irrigation systems and/or sprinklers less than 150 above the ground level are regarded as fluid Category 4 backflow risk and shall only be connected to a mains fed tap/hose connection with double check valve and type DB pipe interrupter or other WRAS Category 4 protection device.

D.4.18 Supplies to Douche Sprays, Vertical Spray Bidets and Toilet Seat Spray Bidets

Domestic water supplies to each douche spray, each vertical spray bidet and each toiler seat spray bidet shall be fitted with point of use Category 5 back flow prevention device on both hot and cold water supplies.

D.5 SANITARY WARE

Sanitary ware shall either, be supplied and installed by the Services Contractor or, Sanitary Ware shall be supplied by the Main Contractor and installed by the Services Contractor as specified.

Where sanitary ware is to be supplied this shall be strictly in accordance with the Architects Schedules and shall be complete with all fixings, brassware and traps. Prior to installation the Services Contractor shall inspect the equipment to verify compliance with specification, condition and completeness, and then stored on site in manufacturers packaging in a suitable secure store.

Sanitary ware shall be fixed in accordance with the manufacturers/suppliers instructions and once installed shall be protected from damage. All sanitary ware accessories shall be assembled and fixed strictly in accordance with the manufacturers' recommendations.

The sanitary ware shall be fixed where applicable with gunmetal screws with plastic covers and the joint at the abutment of the sanitary ware with the adjoining wall; floor or work surface shall be weathered with a fillet of Dow Corning of approved colour.

D.6 WASTE WATER & SEWAGE PUMPING EQUIPMENT

D.6.1 Waste Water Sump Pump

Not Applicable

D.6.2 Sewage Pumping Plant

Not Applicable

D.7 SEWAGE TREATMENT

Not Applicable

D.8 LAND DRAINAGE

D.8.1 Scope of Work

The scope of work covered under this section includes:

- Drainage of fields and gardens to alleviate water-logging
- Collection Drains - the collection and removal of ground water in areas to be drained
- Dispersal Drains - The dissipation of ground water, surface water and clean water discharge

D.8.2 General

Wherever possible drainage shall be designed to ensure all drainage runs to sewers by gravitational method.

Where pumping is unavoidable, the surface water systems shall be designed to minimise the volume of drain to be pumped by separating the services to permit the maximum drain volume by gravitational method.

The work shall be undertaken by a Land Drainage Specialist.

Contractor shall undertake a survey of the area where land drainage pipework is to be introduced to confirm absence of obstructions and other services.

The Contactor shall develop a detailed scheme including the setting out of all pipework and equipment. The scheme shall be submitted for the approval of the Architect.

The installation work shall be undertaken in collaboration the Planning Authority, Tree Preservation Officer, Environment Agency, Landscape Designer, Agricultural Adviser, and other interested parties.

No wastewater shall be redirected to drainage ditches and/or ponds or dissipated by soakaways or other on-site disposal methods without first obtaining approval from the relevant Authority.

D.8.3 Setting Out

The Contractor shall include for true and proper setting out of the contract works. The setting out shall be carried out by experienced operatives with the appropriate equipment.

The Contractor shall ensure the correct positioning, depth, alignment and gradients of all pipework, and equipment. The Contractor shall comply with manufacturers' information and recommendations with regard to installation and future maintenance of items of equipment.

Where a pipe gradient is specified, the Contractor shall ensure this gradient is maintained constant throughout the complete run of pipe.

Where levels are specified the Contractor shall ensure that the installation complies with these with a maximum tolerance of +/- 10mm.

Where a pipe gradient is specified, the Contractor shall ensure this gradient is maintained constant throughout the complete run of pipe with a maximum tolerance of +/- 1.0%.

All measurements shall be taken from site measurements whenever possible. Drawings shall not be scaled. All setting out dimensions shall be confirmed by the Architect prior to installation.

D.8.4 Access

Access for inspection, clearance and cleaning and maintenance shall be provided as Building Regulations Part H and BS EN 752.

D.8.5 Protection

Where pipes are located under any areas likely to be subjected to superimposed loads such as vehicles, stored materials, and buildings suitable protection shall be provided to prevent damage and/or deformation. Protection may be achieved by ensuring sufficient ground cover over pipes or by providing a protective layer over the pipe.

D.8.6 Testing

The complete plumbing and drainage system shall be tested to complete satisfaction and in the presence of the Local Authority Public Health Inspector and in accordance with Part H of the Building regulations.

D.8.7 Filter Drains

Filter drain pipes shall be provided to drain groundwater.

Filter pipes shall comprise proprietary half-perforated or fully perforated clayware drainpipe of minimum 100mm diameter installed within trench lined with geotech membrane. Rigid perforated PVC pipe as manufactured by Marley may be used in shallow installations and where there is no superimposed ground load subject to approval.

The pipe shall sit on 50mm of suitable bedding material and the trench backfilled with Type A (20mm) clean gravel filter material.

The half perforated pipes shall be orientated with perforations uppermost.

The pipe shall be laid to falls of between 1: 200 and 1:100 towards the direction of disposal.

The trench shall be a minimum of 750mm deep and 400 wide with at least 150 gravel cover over the pipe with a further cover of at least 300mm of free draining material with final cover of reinstated excavated material/top soil with turf or other specified finish.

D.8.8 Collection Drains

Collection drains shall comprise proprietary half-perforated clayware drainpipe of minimum 100mm diameter installed within trench lined with geotech membrane. Rigid perforated PVC pipe as manufactured by Marley may be used in shallow installations and where there is no superimposed ground load subject to approval.

The pipe shall sit on 50mm of suitable bedding material and the trench backfilled with type B (6.3 to 10mm) clean gravel filter material.

The pipe shall be orientated with perforations uppermost.

The pipe shall be laid to falls of between 1: 200 and 1:100 towards the direction of disposal.

The trench shall be a minimum of 450mm and a maximum of 1200mm deep and 400 wide and shall extend to the ground surface.

D.8.9 Disposal Drains

Disposal pipes shall be used to disperse surface water or clean water emanating from water treatment systems.

Disposal drains shall comprise proprietary half-perforated clayware drainpipe of minimum 100mm diameter installed within trench lined with geotech membrane. Rigid perforated PVC pipe as manufactured by Marley may be used in shallow installations and where there is no superimposed ground load subject to approval.

The pipe shall sit on 50mm of suitable bedding material and the trench backfilled with type B (6.3 to 10mm) clean gravel filter material.

The pipe shall be orientated with perforations at the bottom.

The pipe shall be laid to falls of between 1: 200 and 1:100 towards the direction of disposal.

The trench shall be a minimum of 750mm deep and 400 wide with at least 150mm gravel cover over the pipe with a cover of at least 300mm of reinstated excavated material/top soil with turf or other specified finish.

D.9 RAINWATER HARVESTING SYSTEMS

Not Applicable

D.10 GREY WATER RECYCLING SYSTEMS

Not Applicable

SECTION E ELECTRICAL SERVICES SPECIFICATION

E.10 MATERIALS AND WORKMANSHIP

All materials and equipment forming part of the final installation shall comply with BS 7671. All materials and equipment shall in addition be fabricated and/or constructed to relevant British and Euro Standards.

The selection and installation of all materials and equipment shall be in accordance with BS 7671.

All equipment shall be capable of withstanding the prospective short circuit current and duration at the position in the system at which it is installed.

All equipment shall have a suitable degree of protection from environmental influence. Unless otherwise specified, a minimum degree of protection of IP 31 is required for switchgear and control gear. Electrical installations shall be of suitable specification for the application.

The installation must comply with all mandatory requirements limiting the spread of fire smoke and other toxic fumes and all requirements of the Fire Prevention Officer, Building Regulations and the Petroleum Officer.

E.11 COMPATIBILITY

All equipment requiring a Low Voltage electricity supply shall be supplied to Site ready to accept an alternating current supply of either 230V/50Hz or 400V/3-Phase/50Hz.

Equipment designed for Low Voltage electrical supplies other than 230V/50Hz or 400V/3-Phase/50Hz shall not be installed whether or not these are provided with conversion equipment such as step-up or step-down transformers.

All electrical equipment shall be compatible with BS 7671 and UK operating conditions.

Equipment terminal identification and wiring colour codes shall be in accordance with BS 7671 and NICEIC Guidance.

All equipment shall be clearly and permanently labelled to indicate the electricity supply requirements.

The Building Contractor shall ensure all equipment used during construction and for the permanent installation is electrically supressed to the requirements of BS EN 55014.

E.12 SERVICES IN MEANS OF ESCAPE ROUTES

Wiring stems in escape routes shall be supported such that they shall not be liable to premature collapse in the event of fire. The requirements of Regulation 422.2.1 shall also apply, irrespective of the classification of the conditions for evacuation in an emergency.

This precludes the use of non-metallic cable clips, cable ties or trunking as the sole means of support. Where non-metallic trunking is used, a suitable fire-resistant means of support/retention must be provided to prevent cables falling out in the event of fire.

E.13 EARTHING & BONDING

E13.1 General

Earthing shall be carried out in accordance with the appropriate sections of BS 7671.

Where a PME earthing termination is provided by the Supply Authority, all earth continuity conductors shall be brought back and shall be bonded to this point in the prescribed manner as laid out in the IEE Regulations. All special requirements imposed by the Supply Authority shall be complied with.

At all main switchgear positions an earth continuity conductor consisting of copper strip having a minimum cross sectional area of 75 mm² shall be provided to bond between the metal sheath and armouring of cables to the main earth terminal on the main isolating fused switch or switchfuse. An earth bonding conductor of copper strip having minimum cross sectional area of 16 mm² shall be provided to bond together all equipment including the metal case of all switches, distribution boards and metal frames. This bonding lead shall be solidly connected to the earth continuity conductor.

The earth continuity conductor in paragraph (c) shall be solidly connected to the earth electrode system, which shall be as specified elsewhere.

All copper strips or tapes shall be manufactured from soft high conductivity copper, un-tinned except where otherwise specified, and where fixed externally, run in the ground through walls, floor etc. Where liable to corrosion they shall be served with corrosion resistant tape or coated with a corrosion resisting PVC sheath. Where run in the ground they shall be laid on sand and protected with interlocking cable tiles.

A removable test link shall be provided inside the building as near as possible to the earth electrode, for isolation of the earth electrode for testing purposes.

Earthing of sub-main distribution equipment shall be made by means of connections to the sub-main feeding cable where these are paper insulated or PVC insulated and armoured, MIMS or conduit. The installation shall be carried out in accordance with relevant clauses of the Specification. On these, the earth continuity resistance and impedance shall not exceed the values specified in the IEE Regulations.

Where the Supply Authority provides an earth terminal or earthed cable sheath, the earth continuity conductor copper strip, with their permission, may be connected and bonded to this point. All exposed steelwork shall be bonded to the earth continuity conductor.

Where an earth electrode system is specified it shall, unless otherwise detailed, comprise solid drawn high conductivity rod or rods in the arrangements specified to suit site conditions.

Earth electrode rods shall be of proprietary manufacture, 15 mm diameter driven into the ground to a minimum depth of 2.4 m, made up of sections 1.25 m long with internal screw and socket joints, and fitted with hardened steel tip and driving cap. Connections to the rod shall be by means of a purpose made clamp, below ground level in a concrete inspection pit having removable cover.

Where an earth rod (or earth rods) is used, the earth resistance shall be tested in the manner described in the IEE Regulations, by the Contractor in the presence of the Engineer, and the Contractor shall be responsible for the supply of all test equipment. The maximum earth resistance shall be 0.5 □ for the installation, and less where the protection scheme requires it.

Earth plates shall only be permitted where detailed in the Schedule or on the Drawings.

Where copper strip is fixed to the building structure it shall be by means of purpose made brass or bronze saddles.

Fixings shall be made using purpose made plugs and brass screws.

Fixings requiring the drilling of holes through the strip shall NOT be used.

Joints in copper strip or tape shall be tinned before assembly, riveted with a minimum of two copper rivets and sweated solid.

Where holes are drilled in the earth tape for connections to items of equipment the effective cross sectional area of the connection must not be less than that required to comply with IEE Regulations.

Bolts, nuts and washers for any fixing of the earth tape shall be brass of the high tensile grade, or where liable to corrosion, they shall be bronze.

The Electrical Contractor shall carry out the bonding to earth of all components as necessary within the completed building to be strictly in accordance with the requirements of BS 7671 and BS Code of Practice CP 1013.

E.13.2 Equipotential Bonding

The Contractor shall carry out all necessary Main and Supplementary Bonding to meet the BS 7671 and this shall be included in the Tender Price.

This shall include supplementary bonding in connection with the mechanical and sanitation services installations and the exposed extraneous conductive parts which form part of the overall building works including structural steelwork and staircases and but which are not necessarily part of this Contract.

E.13.3 Electrical Continuity of Pipework and Ductwork Systems

The Contractor shall ensure that all pipework, ductwork and other metallic distribution systems are electrically continuous and shall verify continuity by testing.

Metallic pipework joints formed by tapered threads or sweated joints shall require no additional bonding if found to be continuous by testing. Other jointing methods shall be bridged by means of copper links braided where appropriate. No element which has its greatest dimensions less than 1.0 m in length need be bonded provided it is not an exposed conductive part as defined by BS 7671.

The Contractor shall provide a bonding point at the origin of distributed mechanical systems and shall connect to the building's main bonding system and test for continuity.

E.13.4 Additional Requirements for Supplementary Equipotential Bonding within Bathrooms, and Shower Rooms

These particular requirements apply within Zones 0, 1, and 2 as defined by BS 7671/IEE Wiring Regulations and apply to all Bathrooms and Shower Rooms. In the following, the term ‘ZONE’ shall mean zones 0, 1, and 2. BS 7671 currently defines the ZONE as being within a vertical dimension of 3m above the floor level and a horizontal dimension of 3m from the shower or bath.

These particular requirements shall not remove or limit the responsibility upon the Contractor to comply with BS 7671.

Supplementary bonding conductors shall have cross sectional area not less than 4.0mm2 and be sheathed green/yellow. Bonding conductors shall have greater cross sectional area where required to meet BS 7671.

The CPC may be used as a supplementary bonding conductor subject to this having a cross sectional area not less than 4.0mm2.

The CPC of ALL lighting and power points within the ZONE shall be bonded to all extraneous conductive parts within the ZONE including (but not limited to) metal wastes, metal baths and shower trays, metallic domestic hot and cold water pipework, metallic heating pipes/radiators, ventilation ductwork/grilles/registers, and the metallic sheath of electric underfloor heating cables.

Supplementary bonding conductors may be ‘daisy chained’ one item to the next before being bonded to the local metallic domestic hot and cold water pipework or individual items may be bonded directly back to the local metallic domestic hot and cold water pipework.

Supplementary bonding shall be carried out within the ZONE if at all practical. If this is not possible, supplementary bonding shall be carried out in close proximity to the ZONE. Close proximity shall mean in the same room, within the ceiling void immediately above the room, in the floor void immediately below the room or in a service void/cupboard immediately adjacent to the room.

Bonding clamps shall be complete with Safety Notice to BS 951, which shall read ‘Safety Electrical Connection – Do Not Remove’.

All bonding connection points shall be accessible. Where any bonding connection is to be concealed behind removable paneling/flooring, the Contractor shall demonstrate to the Engineer that all bonding has been satisfactorily completed prior to concealment.

A clear and complete record of the installation of all supplementary bonding shall be provided in the form of Record Drawings provided by the Contractor.

E.14 FIRE STOPPING

Suitably rated fire stopping shall be provided by the Electrical Contractors where cables, trunking or trays pass through fire compartmentation.

E.14.1 Cable Trunking

Cable trunking shall be fire stopped when passing through fire rated slabs or walls by means of mineral wool internally and mineral wool/epoxy resin externally. A short fixed section of trunking cover shall be used at fire stop positions.

E.14.2 Cables

Where cables pass through fire rated slabs or walls they shall be provided with galvanised iron sleeves packed with mineral wool.

E.14.3 Luminaires

Luminaires recessed into suspended ceilings shall be provided with propriety fire hoods suitably rated to maintain the fire integrity of the ceiling.

E.15 FIXING OF EQUIPMENT

All equipment, conduit, conduit fittings, cables, boxes and enclosures etc., comprising the installation shall be securely fixed, to the satisfaction of the Engineer.

All fixings to concrete and brickwork shall be by means of proprietary make of wall plugs and screws of a size and length to suit the structural material and load to be supported. The holes in walls etc., shall be drilled with masonry drills, and fixing to brickwork shall be made in the bricks wherever possible and not in the bond.

All fixings to structural metalwork shall be made by means of purpose made clamps. Structural Steelwork shall not be drilled.

The clamps should generally be of steel, with adequately sized clamping nuts and bolts fitted with a locking device.

Where structural metalwork is aluminium the clamps shall also be of aluminium or other metal, which will not cause corrosion when in contact with aluminium. The electrical installation equipment shall be fixed to the clamps by means of not less than two screws.

All clamping devices shall be galvanised or painted with a rust resisting primer, two undercoats and one gloss coat of paint, of the colour specified elsewhere, before installation. Any damage to paintwork shall be made good after installation and steel nuts and bolts etc., shall be similarly treated.

Where galvanised equipment, conduit etc., is to be installed, the fixing screws etc., shall be galvanised, sheradised or brass.

Heavy equipment shall not be fixed by means of plugs. Approved purpose made clamps, brackets or patent fixing bolts e.g. Drill anchors, loose bolt Rawlbolts etc. shall be used.

E.16 LABELLING

Labels fitted to switchboard, distribution boards and separate items of switchgear shall be of laminated plastic material, "Traffolyte" or similar approved equal, engraved, coloured black on white background, or as otherwise specified, with lettering not less as 5mm high, approved by the Engineer, and secured by means of round head or instrument head screws and nuts with appropriate washers.

Emergency switching devices shall have labels with white letters on a red background. Weatherproof equipment, distribution boards, external isolators, etc., shall be provided with engraved brass labels infilled in black with characters to the above dimensions, and fixed as above.

Labels on switchgear shall indicate:

- Reference number of the switch where applicable
- The specified current rating, voltage, phase colour and incoming cable size and type
- The part of the distribution system controlled.

Labels on distribution boards shall indicate:

- The reference number, where applicable
- The function, e.g. lighting, power, heating etc, voltage, phase colour and incoming cable size and type
- The reference number or other description of the controlling switchfuse or fused switch.

The lettering of all labels shall be not less than 5 mm.

The Schedule and details of the labels shall be submitted to Engineer for approval by the Contractor to suit the program of works.

E.17 PAINTING

All switchgear, and other items of electrical equipment housed within fabricated metal enclosures, shall be finished with one coat of rust inhibiting paint, one undercoat followed by two finishing coats of paint. The final exterior colour shall be as specified on the Drawings or in the Schedules. Switchboards and electrical equipment to be located externally shall be zinc sprayed, painted one coat of rust inhibiting paint, one undercoat, and shall be finished with two coats of superior quality oil and weather resisting paint.

E.18 TESTING, CERTIFICATION & HAND-OVER

The Electrical Contractor shall give the Engineer three working days' notice prior to carrying out any inspections or tests.

Continuity of ring circuit final conductors shall be carried out in accordance with BS 7671. The continuity of protective conductors shall be verified at all outlet points and switchgear.

Insulation tests shall be made with all circuit breakers and switches on and lamps removed (where practicable). If a value of 5 M Ohm is achieved for a distribution board, individual final circuit tests may be omitted. A 1000 volt Megger shall be used. The minimum insulation

value permitted phase to phase, phase to neutral, phase to earth, or neutral to earth, is 10 M Ohm for a single final circuit. Insulation tests on MIMS cables should not be carried out until 72 hours have elapsed after sealing.

Earth fault loop impedance tests shall be carried out using a direct reading instrument at all switchgear assemblies and at the furthest point of each final circuit. The contractor shall ensure that the impedance measured is such that the maximum permissible disconnection time is not exceeded.

Tests for correct phase rotation shall be made for circuits supplying three phase motors.

Fire Alarm System, Intruder Alarm Systems, TV/SKY Installations and Central Emergency Lighting Systems shall be tested and commissioned by the Specialist Installer/manufacturer who shall subject the system to full functional test as appropriate to be witnessed by the Engineer and a Certification of Satisfactory Operation shall be forwarded to the Engineer. Fire Alarm and Emergency Lighting Systems shall be tested in the presents of the Fire Officer/Building Control Officer.

Where the design of the installation does not form part of the Contract, the Services Contractor shall be responsible for the Construction of the installation and, on satisfactory completion of the works, the Electrical Contractor shall complete and sign the Completion and Inspection Certificates accordingly all as prescribed in the BS 7671 (IEE Wiring Regulations).

Where the design of the installation forms part of the Contract, the Services Contractor shall be responsible for the Design and Construction of the installation and, on satisfactory completion of the works, the Electrical Contractor shall complete and sign the Completion and Inspection Certificates accordingly all as prescribed in the BS 7671 (IEE Wiring Regulations).

Immediately on completion of the installation and commissioning of the system, the Contractor shall provide two sets of completion certificates, which shall be contained within the Operating and Maintenance Manual as follows:

Electrical Installations as BS 7671
Fire Alarm Installations as BS 5839
Emergency Lighting as BS 5266
Lightning Protection as BS EN 62305
Security System as NACOSS

On completion, the Contractor shall meet on-site with the owner/occupier as appropriate, to formally hand-over the installation and to demonstrate operation and routine maintenance requirements.

See Section G for additional requirements.

E.20 PRIMARY DISTRIBUTION

Unless otherwise specified, the installation of the incoming supply up to the meter position shall be undertaken by the relevant Network Company. The installation of the meter shall be carried out by the nominated Electricity Supply Company. The installation of the main supply cables from the meter and all the distribution within the building shall be carried out by the Contractor.

Where specified for a multi-ownership or multi-tenancy building and where it is specified that each owner, tenant, user or shall be provided with a Supply Company Meter, the Contractor shall, subject to agreement with the Network Company, install one or more primary fused distribution panels, as Ryfield or approved. The Network Company shall install the incoming supply and connect to the distribution panel and the Contractor shall extend primary mains from the panel to run and terminate at agreed meter positions with space left read for the installation of meters by the Supply Company. Mains services between the panel and meters shall be contained in steel conduit or trunking as specified by the Supply Company and shall be routed within Landlords/Common areas.

Where specified, the Contractor shall provide a suitable incoming meter panel which shall incorporate primary fused supplies and individual Supply Company Meters within a single enclosure. In this case the Network Company shall install the incoming supply and connect to the meter panel and the Contractor shall be responsible for the installation of all electrical services from the panel to serve the various users within the building.

|

In the case of apartment blocks, electricity services between meters and the residential units may be routed through purpose constructed cable ducts but these must be wholly located within the demise of the Landlords Areas of the building. Required access to such cable ducts may only be achieved from Landlords Areas.

Electrical services either before or after the meter shall not pass through the demise of any residential unit or other than the unit directly served by the supply.

Residential Electrical installations shall be in accordance with Building Regulations Approved Document Part P.

E.21 CONDUIT SYSTEMS

All cables, other than where PVC/SWA/PVC, "Hituf", MIMS or trunking is specified, shall be run in concealed steel or PVC conduits except as E.3.4 where conduits shall be surface mounted galvanised steel. The clause shall not apply where the use of galvanised capping has been specifically permitted, or above plasterboard ceilings where cables may lie on top of the insulation.

E.21.1 Steel Conduits

Steel Conduits shall be Class 2 heavy gauge welded to BS EN 61386 for screwed conduit installations and Class 3 heavy gauge solid drawn and screwed for flameproof installations.

Screwed conduit boxes and rigid conduits shall comply with BS EN 61386. Conduits and fittings shall be finished with Class 2 stove enamel black except where hot dip zinc coating is specified.

Conduits shall be threaded to the correct length in accordance with BS 4568 and each length shall be reamed at both ends to remove all sharp edges and burrs after screwing.

Conduits shall be cleaned off all lubricant and swarf before installation. Threads already cut shall be cleaned by having dies run over them and wiped clean.

Conduits shall be protected from weather and mechanical damage during storage and installation at site.

E.21.2 Rigid PVC Conduits

Conduits, conduit boxes and fittings shall comply with BS EN 50086 and BS 4607.

Rigid conduits shall be of tubular form except where oval conduits are specified.

All rigid PVC conduits (except oval) shall be classified for heavy mechanical stresses and have a temperature classification –5C, and be non-flame propagating.

E.21.3 Conduit Installation

All conduits shall be installed neatly and as unobtrusively as possible, and parallel to general building lines when run on the surface of walls and ceilings.

The routing shall be as approved by the Engineer before installation and spaced at the standard dimensions of multiple saddles where two or more conduits are run together.

The conduit installation shall be checked for rigidity and mechanical damage where run in floor screed and be provided with temporary protection before the screed is laid. Any damaged conduit runs shall be renewed.

Conduits shall be laid in a straight line from point to point where concealed.

Protection shall be provided at terminations by plugs and caps until installation of cables and swabbed dry and proved clear before wiring is commenced.

Steel conduits shall be painted with rust inhibiting paint after erection where threads are exposed or where the finish is damaged.

Conduits shall be screwed and butted solidly into boxes, couplers and conduit fittings etc., and be satisfactorily mechanically continuous throughout.

Steel Conduits shall be tested for satisfactory electrical continuity before plastering or screeding, and before cables are drawn in. The tests shall be witnessed by the Engineer or his representative.

The installation shall have the minimum of running couplings. Where provided couplers shall have machined end faces for locknuts having machined faces. (steel conduits only) Conduits shall be bent or set using a purpose made bending machine having a former which causes minimal deformation of bore.

Threading shall be parallel with the bore. All conduit shall be held in an efficient pipe vice for screwing. Where connected to equipment or trunking etc. not having tapped entries, smooth bore male brass bushes shall be used inside the equipment and couplers having machined end faces outside to ensure electrical continuity. All bushes shall be fitted with spring, shakeproof or compression washers. Under no circumstances will the use of any type of ring bush be permitted. (steel conduits only)

The installation shall be in accordance with the current edition of IEE Regulations with respect to the maximum allowable number of cables in conduits and provided with draw-in facilities for easy installation or withdrawal of any or all cables.

Conduits shall be installed horizontally or vertically only in wall chases or on the surface of walls. Horizontal runs shall be avoided wherever possible.

Steel conduits shall be installed with a running coupling inserted within 300 mm above floor or below the ceiling on all vertical drops or risers.

Conduits shall be supported 150 mm each side of any bend, set, adaptable or draw-in box.

The installation of steel conduits shall use malleable iron distance saddles for surface runs exposed to view.

Spacer bar saddles shall be provided when installed in roof spaces, above suspended ceilings, or in other spaces, as instructed by the Engineer.

Crampets shall be used for fixing when installed in screeds or in chases, which will be rendered and plastered, such as wall chases etc.

Saddles or crampets shall be spaced at distances of:

Conduit Size	Vertical/ Horizontal Spacing
20 - 25mm	1.2 m
32 - 40mm	1.5 m
50mm	1.8 m

Saddles shall be rigidly fixed to the structure by means of proprietary make of wall plug and screws to a depth to suit the structure.

All fixing holes in walls etc. shall be drilled with masonry drills. Fixing to brickwork shall be made in the bricks and not in the bond.

Where condensation in the conduit is likely to occur, the sections shall be isolated by means of a conduit box filled with plastic compound of the non-hardening type, located in the higher position in the conduit run.

Adequate drainage points shall be provided where condensation is likely to occur.

Back outlet boxers shall be provided where a surface conduit turns through a wall.

The Engineer must be notified in writing two working days before any conduit is concealed.

No conduit shall have more than two right angle bends in any run without the provision of a draw-in box, or have runs of more than 10.0 m without a draw-in box on straight lengths, or 7.5 m on lengths containing a bend or bends.

Sleeves shall be provided where conduits pass through concrete floors.

Conduits shall be installed a minimum distance of 150 mm from all other services where possible.

Conduits shall be provided with special expansion couplings where they cross expansion joints in the building structure. Electrical continuity through these joints must be maintained.

E.21.4 Galvanised Conduits

Galvanised steel conduits shall be provided for underground or buried services, Plant Rooms, external or exposed to atmosphere locations, in all damp locations; in all ducts and subways, within HVCA plant and wherever necessary to provide protection against corrosion and rusting.

Conduits shall be fixed using galvanised saddles and galvanised sheradised or brass screws.

Conduits shall be painted with zinc rich paint where threads are exposed or the finish is damaged.

Galvanised accessories only shall be installed.

E.21.5 Metallic Flexible Conduits

Metallic flexible conduits shall be used to all items of equipment which are removable or which are subject to vibration or adjustment, including all motors or where otherwise specified. No other application of flexible conduit shall be approved.

Flexible conduits shall be PVC sheathed and of ample capacity for the number of cables.

Flexible conduits shall have a minimum length of 300 mm and have sufficient length to allow full range of withdrawal, adjustment or movement necessary. The termination at each connection shall be by factory made clamps.

Flexible conduits shall be run with earth conductors of minimum size 1.5 mm^2 insulated cable installed internally neatly taped or tied using cable ties, to the conduit and fixed at each end of the conduit with earth clamps.

The installation shall be in accordance with BS EN 50086.

Weatherproof grade conduit shall be used where installed external to the building or exposed to the weather, or in any position where ingress of moisture could occur.

E.21.6 Steel Conduit Boxes

Conduit boxes shall be of malleable cast iron to BS EN 61386 finished black enamel, or galvanised as appropriate and be provided with lids of mild steel 1.6 mm thick, finished to suit the box and secured in position by brass roundhead or cheese-head screws of a length just sufficient to secure the lid.

Boxes shall be provided with tapped spout entries except where arranged for back entry looping.

Galvanised weatherproof type shall be provided where installed externally, with mineral jelly between the surface of the joint, or alternatively be fitted with a rubber lid gasket.

Tangent type shall be used at right angle changes of direction where necessary to form a neat and unobtrusive run.

Oversized lids shall be provided when used as flush inspection boxes or with break joint rings at lighting termination points and ceiling switches.

Extension rings shall be installed where the distance between the box and the finished ceiling or wall surface exceeds 10 mm on flush installations.

The edge of the box shall be flush with the finished surface, or alternatively, extension rings shall be used.

Boxes shall be firmly grouted in where provided for switch and socket outlet points in brick or concrete.

E.21.7 Adaptable Steel Conduit Boxes

Adaptable boxes shall be manufactured from sheet steel or cast iron and used instead of BS EN 61386 conduit type boxes where two or more parallel conduit lengths are jointed together.

Earthed steel barriers shall be provided where necessary to segregate services.

Where used externally galvanised malleable cast iron type shall be used with lids made watertight. Galvanised boxes shall be provided where used with galvanised conduit.

Overlapping lids shall be fitted where used on flush installations.

Adaptable boxes shall be fixed in accessible positions and firmly screwed to the fabric of the building.

Adequate box size shall be used for the number and size of cable entering and leaving, and for the largest size of conduit connected to the box.

E.21.8 PVC Conduit Fittings

Small circular conduit boxes, adaptable boxes and extension rings shall be PVC and where used as outlet boxes be provided with brass earthing terminals. Where used with luminaires they shall have rigid metal fitting fixing lugs.

PVC saddles shall be PVC of the standard spacer bar type comprising a spacer base approximately 3 mm thick suitable for fixing to the structure with a single screw. The strap shall be fixed to the base by two screws.

E.22 CABLE TRUNKING

E.22.1 Steel Cable Trunking

Steel cable trunking shall be manufactured from sheet steel, rust-proofed and finished with approved paints and shall be of an approved manufacture.

Trunking shall be used where shown on the Drawings or in the Schedules, where multiple conduit runs would otherwise occur, or in approved positions as directed by the Engineer.

Trunking shall be to the following gauges:

1.25 mm - Up to 50 mm x 50 mm or equivalent cross sectional area
1.6 mm - Up to 200 mm x 200 mm or equivalent cross sectional area
2.0 mm - Above 200 mm x 200 mm or equivalent cross sectional

Trunking shall be fitted with drip proof, close fitting lid securely fixed to the trunking by an approved means that will avoid damaged to the cables.

Earthed steel partitions shall be used to provide the necessary number of compartments needed to segregate the services.

Trunking shall be free from all sharp edges and projections and shall be electrically and mechanically continuous throughout and supplied with copper links between each length, and between each length and fitting, i.e., tee, elbow etc., to ensure earth continuity. Earth continuity shall comply with IEE Regulations.

Manufacturer's standard stopped end pieces shall be used to terminate all runs of trunking.

Overlapping cover plates shall be used when installed flush with the building fabric. The finished edge of the trunking shall be flush with the finished surface of the building.

Manufacturer's standard radiused or gusseted bends or tees as only be used at changes of direction.

Trunking shall be fitted with Manufacturer's standard end plates and flares where detailed to connect items of equipment.

Internal fire barriers shall be provided where the trunking passes between fire compartments and across smoke barriers.

Cable retainers shall be fitted at manufacturer's specified intervals and pin rack strain relief shall be fitted on vertical runs.

Male brass bushes and conduit couplers shall be fitted where conduit terminates.

E.22.2 PVC Cable Trunking

PVC trunking shall comply with BS EN 50086 and be classified for heavy mechanical stresses with a temperature classification of -5 and be non-flame propagating.

The covers shall be removable in easily handled sections over the entire length. Standard manufacturer's fittings shall be used at intersections between differing trunking sizes.

All fixings shall be so arranged that there are no screw threads projecting into the trunking.

All bends and sets shall be prefabricated by the manufacturer.

E.22.3 Decorative Skirting and Dado Trunking

Decorative 2 or 3 compartment aluminium or PVC skirting and dado trunking shall be provided as detailed on the drawings. Trunking shall be run horizontally and vertically and shall be set out with laser level.

Trunking shall comprise back plate, cable carriers, cable segregation inserts, cross-overs, front covers, accessory boxes and proprietary bends, ‘T’s and end caps to form a complete, continuous and integrated proprietary system.

The electrical accessories and TV/telecom outlets shall be provided as indicated on the drawings and to the types specified elsewhere.

The trunking shall be fixed in accordance with the manufacturer’s instructions and sufficient fixings shall be provided to ensure no deflection or stress is caused to the trunking in use.

Segregation of circuits shall be in accordance with BS 7671.

Any damage caused to the trunking prior to hand-over including surface scratching shall be repaired at the Contractor's expense.

E.23 CABLE TRAYS

Cable trays shall be provided for vertical and horizontal routing of LV and ELV cables. Separate trays shall be provided for LV and for ELV services in accordance with BS 7671 and the trays shall be spaced apart to ensure segregation of services.

Trays may be used for fixing LV and ELV cables in roof, ceiling and floor voids, and in designated services cupboards and risers. Elsewhere conduit or trunking containment shall be provided.

Individual sections of metal trays shall be bonded to together and to earth with minimum sheathed CPC of 4.0mm2.

Trays shall be adequately sized to support the cables without undue bunching.

Steel trays shall be of the heavy-duty type of perforated galvanised steel of not less than 0.9 mm up to 100 mm width, 1.25 mm from 100 mm to 150 mm width, and 1.6 mm from 150 mm to 300 mm width. Bends and 'T's shall be factory made Where cut sections are used for sets they shall be free from sharp edges and joined by means of galvanised fish plates bolted to each section. Cut ends shall be painted with zinc rich paint. Any holes and slots cut into the trunking for cable routing shall be suitably bushed.

Trays shall be supported by suitable stand off brackets at intervals necessary to provide a rigid fixing. Fixings to masonry shall be by expansion type masonry plugs or bolts and to timber by brass screws. Fixings shall be provided at sufficient centres to ensure no undue deflection with the total weight of cable likely to be carried on the tray.

Adequate clearance for installation and removal of cables of at least 100mm shall be provided between trays and structure.

Cable shall be fixed to the tray by means of proprietary forms of plastic or copper cable clips, saddles
or straps and by means of copper or brass saddles and clips where high temperatures or humid conditions are likely to be experienced. All saddles, clips, straps, etc. shall be fixed to the tray by brass screws or bolts and nuts.

E.24 BURIED DUCTS FOR CABLED SERVICES

Where indicated on the drawings, the Contractor shall provide buried ducts for the containment of cables. Cable ducts shall be colour coded as applicable for the services conveyed – Black for Electrical Power, Grey for Communication Services and Orange for Site Services.

The installation shall include trenching, 50mm sand blinding, laying the duct, surrounding the duct with pea shingle to a cover of 50mm, reinstatement of the ground, compaction and provision of surface finish as Architects specification.

Ducts and access chambers shall be manufactured by Polypipe Ltd types Rigiduct or Rigicoil to suit application. Unless otherwise stated, the minimum duct size shall be 100mm.

Cable ducts must be provided in all instances where cables pass under roadways, drives, and all hard landscaped surfaces. This includes SWA cables and cables for ELV applications and voice/data and other communication and alarm systems.

Ducts shall be suitable for the services conveyed and shall generally be rigid or flexible MDPE and where located at risk from heavy traffic these shall be HDPE.

Access positions in the form of purpose constructed PVC accessible chambers shall be provided at duct junctions and in any case at no greater distances than 30m centres for purpose of installing and removing cables. Access chambers shall have bolted gasketted lids suitable for the application and location. A separate access chamber shall be provided for each of the following three services – Medium and High Voltage services (over 500V); Mains Voltage services (Low Voltage 230V/400V services) and ELV services (communication, signal and alarm services 0 to 50V).

Where buried ducts are located in open ground (gardens, fields, verges etc) these shall be buried to ensure a minimum ground cover of 600mm. The method of installing and protecting cable ducts where these are routed under roadways, car parks, and any areas subject to vehicular traffic shall be agreed with the Structural/ Civil Engineer or Architect as appropriate.

A 150 wide plastic warning tape shall be laid continuously along the length of the duct 200mm above the top of the duct with black letters on yellow background "CAUTION – ELECTRICITY CABLES". Where high voltage cables (exceeding 500V) are installed, additional "HIGH VOLTAGE CABLES" safety labelling shall be provided. Identification labelling of each service shall be provided within each access chamber in the form of permanent tamper-resistant cable tags which shall specify the cable function, circuit reference, cable origin and destination.

Irrespective of whether or not cables are installed within cable ducts in this Contract, the Contractor shall leave a draw rope in each section of duct.

Change of duct direction shall be achieved by long radius bends or by access chamber. Ducts shall be laid with constant and uniform gradients. Where an abrupt change of depth is required this shall be achieved by means of an access chamber – the exception being at the final entry into a building through the floor slab which shall generally be by long radius bend.

Where a cable duct enters a building through the floor slab, the duct shall be sealed to the slab and/or to the damp-proof membrane in accordance with the Architects details. Generally the duct shall extend to 200mm above the floor finish. Once cables have been installed within the ducts and where ducts are installed for future use, all open duct ends within the building shall be sealed with purpose made end caps with cable entries fitted with rubber grommets or other approved method.

The complete cable duct and access chamber installation shall be water-tight.

The routes, depths and sizes of all cabled ducts and access chambers shall be recorded and detailed on Record Drawings which shall also identify the services conveyed within each duct.

E.25 LOW VOLTAGE CABLES (500 VOLT)

E.25.1 Cables – Generally

Cables shall be 450/750 volt grade and shall be provided with stranded copper conductors wherever commercially available.

PVC insulated cables shall be LSZH rated unless otherwise stated in any accompanying Specification.

Cables shall be coloured in accordance with the IEE Regulations. Coloured sleeves shall be used to identify all final visible cable connections within equipment enclosures where the colour coding of the cable sheathing is at variants to the correct colour coding as BS 7671.

Cables shall be delivered to site with each coil having its seal intact and bearing the name of the manufacturer, classification, size, description of cable, length and grade.

Cables shall be installed without joints. Live conductors of lighting circuits shall be taken direct to switches. Neutral conductors shall be looped at lighting points.

Segregation of cables shall be in accordance with IEE Regulations.

Shake-proof or spring washers shall be fitted on all bolted connections.

Cables passing through luminaires shall be the heat resistant type to BS EN 50525.

Cables used for connections to any lamp holder or any other appliance shall be suitable for the maximum operating temperatures.

Approved cable retaining straps shall be provided where trunking is installed with the lid facing downwards.

Pin rack type strain relief shall be provided at each storey level in vertical trunking runs.

Straight through joints shall not be made without the express permission of the Engineer except where the run length exceeds the standard drum length.

Tee joints shall only be used where indicated on the drawings.

Before installation of a joint of any type, the proposed jointing method and materials must be submitted to the Engineer for approval.

E.25.2 Termination of Cable Conductors

Conductors shall be terminated by one of the following methods unless otherwise stated:

Sweated lugs of the appropriate size for the cable used
Compression type lugs
Pinch screw type terminals of a type, which do not spread the conductors
Clamp type terminals

Conductors shall be doubled back on themselves for all single connections of conductor size up to and including 2.5 mm².

Conductors shall be terminated within a box or within the luminaires or other appliance to be connected.

E.25.3 Flexible Cables and Cords

Flexible cables and cords shall not have conductors smaller than 1.0 mm² unless otherwise specified and shall be of circular construction.

Cables and cords shall be of the colour indicated on the Drawings or in Schedules.

Cables and cords shall be either PVC to BS 6004 or Butyl Rubber to BS EN 50525 where used in higher temperature conditions.

PVC insulated to BS 6004 shall be provided where used for pendant luminaires, adjustable lamps or other portable appliances, unless otherwise specified.

Cables used for connections to any lamp holder or any other appliance shall be suitable for the maximum operating temperatures.

Heat resistant silicone rubber flex cables complying with the appropriate British Standard, shall be used for connections to luminaires with a loading of 150 watts or more.

The earth conductor termination shall be of sufficient length to ensure that no undue stress is placed upon it.

Cables and cords shall be suitable to support any mass they are required to suspend. For heavy luminaires such as chandeliers and lantern fittings the electrical flex shall not be used for suspension but instead other mechanical suspension means shall be provided.

E.25.4 PVC Insulated Non-sheathed Cables (PVC Singles)

Cables shall be to BS EN 50525 and shall be 300/500 volt grade. PVC singles shall only be installed within conduits or trunking.

The minimum cable conductor size shall be 1.5 mm². The minimum cable conductor size used for ring main circuits shall be 2.5 mm². The minimum cable conductor size used for cooker supply shall be 6.0 mm².

Rubber grommets shall protect the cable at all entry points to back boxes and luminaires.

E.25.5 PVC Insulated PVC Sheathed Twin and Earth Cables

Where specifically permitted, twin and earth cables may be used in lieu of pvc insulated non-sheathed cables in conduit/trunking for the electrical final circuit wiring.

Twin and earth cables shall be installed within conduit where built into the structure or where inaccessible for future re-wiring. Cables shall be protected by conduit where installed as wall drops to switches and socket outlets.

Cables shall be to BS EN 50525 and shall be 300/500 volt grade.

The minimum cable conductor size shall be 1.5 mm². The minimum cable conductor size used for ring main circuits shall be 2.5 mm². The minimum cable conductor size used for cooker supply shall be 6.0 mm².

Rubber grommets shall protect the cable at all entry points to back boxes and luminaires.

E.25.6 PVC Insulated PVC Sheathed Single Core Cables - Meter Tails

Cables shall be to BS EN 50525 and shall be 300/500 volt grade. PVC Sheathed PVC Insulated Single Core cables shall be used for the short tails between the meter and the Consumer Unit.

Wiring shall be kept to a minimum length, shall not exceed 2 metres in, and shall be installed in accordance with the Electricity Supply Company's requirements. Wiring shall be routed to avoid risk of mechanical damage. Where wiring is at risk from mechanical damage, cables shall be contained within conduit or trunking.

Meter Tails shall be in installed in accordance with the Electricity Supply Companies requirements and in any case shall be run in a minimum size of 25.0mm² phase and neutral with PVC insulated earth conductor sized in accordance with IEE Regulations.

E.25.7 PVC Insulated Steel Wire Armoured Cables

Cables shall be in compliance with BS 6724 for PVC/SWA/PVC cables 300/500 volt grade.

SWA cables shall be fixed by cleats or supported by cable tray in accordance with BS 7671 Regulations for cables less than 40 mm diameter. Cables having diameters exceeding 40 mm shall be fixed at centres as recommended by the manufacturer.

Sleeves shall be provided where cables pass through floor slabs or walls which are to be fire stopped where required.

Cables shall be installed in such a way that the minimum bending radii required by the BS 7671 Regulations are maintained or exceeded.

Cables shall be marked at each end, change of direction and 10 m interval with brass tag labels indicating the cable size and circuit.

Cables shall be terminated in exterior or interior type compression glands, suitable for the environmental conditions. The glands shall provide adequate anchorage and cross joint bonding of the armouring. All glands shall be fitted with PVC shrouds, which completely encase them.

E.25.8 Mineral Insulated Metal Sheathed Cables (MICC/MIMS)

MIMS cables shall be sheathed with copper and comply with BS EN 60702 for 600/1000V heavy-duty grade for all circuits.

Conductor sizes shall comply with the appropriate rating tables of the IEE Regulations.

Cables shall be of only one Manufacturer on any one Contract.

Cables shall be fitted with cold screw-on pot seals, filled with plastic compound and with universal type glands in situations where temperature will not exceed 80°C.

Cables shall be fitted with flameproof type seals when fitted to flameproof equipment.

Silicone bonded glass fibre caps and suitable compound shall be provided where temperatures are likely to reach 150°C.

Cables shall be terminated using polychloroprene, polyvinyl chloride or silicone rubber sleeving on the conductors to suit the temperature conditions and the equipment. Sleeving shall be anchored and sealed into pot type seals.

Cables shall be terminated with coloured sleeves or tapes complying with the proper colour code for the identification of the conductors.

Fixing shall be by means of copper saddles respectively to match the sheath of the cable. Saddles shall be fixed to walls, ceilings etc., by means of purpose made plugs and screws as detailed for conduit work.

Saddles shall be spaced as given below:

Overall diameter of Cable	Maximum spacing of fixings
Not more than 9 mm	300 mm
Above 9 mm	600 mm

Where several cables are run together, multiple saddles shall be used. Fixings shall be as detailed for conduit work.

Cables shall be run on cables trays where multiple runs occur in plant areas, roof and floor spaces, ducts and crawl-ways etc. Saddles shall be fitted using brass round head screws and nuts.

The Contractor shall test all cables in the presence of the Engineer or his representative not less than 72 hours after installation and completion of seals. Any cables not giving an infinity reading when tested with a 500 V □□ meter shall be re-sealed by the Electrical Contractor, at his own expense.

Testing shall be carried out before and immediately after covering by concrete, plaster, or being buried in the ground, for continuity and insulation resistance to verify that mechanical damage has not occurred.

Cables shall be protected as detailed for conduit installations where the final finish floor screed, plaster etc. is not carried out immediately after installation.

Protection shall be provided by sleeves where passing through floors, walls, ducts or trenches.

Protection shall be provided by means of cable trunking or conduit to a minimum height of 300 mm, or as directed by the Engineer or his representative, on walls after passing through floors, and arranged to provide a neat finish.

Cables shall be terminated with brass locknuts and female bushes in equipment where clearance holes are provided and clearance is available. PVC sheathed cables shall be provided where installed on the surface in damp or humid conditions, and where buried in the ground, plaster or floor screeds, with PVC hoods and shrouds provided in particularly corrosive areas, or where otherwise specified.

Cables shall be installed using galvanised boxes in damp or humid conditions. At luminaires, socket outlets or switch positions, jointed by connections into the terminals provided. Where switch or loop in terminals are not provided, jointing shall be made by pinching screw terminals or flat clamp type connectors.

Installation of cables shall be only by tradesmen who have had a course of instruction in handling and jointing of MIMS cable.

Cables shall be installed using only the materials and bonding, stripping and sealing tools recommended by the Manufacturers. Stripping and sealing tools used for copper shall not be used on aluminium, and vice-versa.
The installation shall be in accordance with IEE Regulations.

Cables shall be laid and protected with sand and interlocking cable tiles or PVC marker tape as for paper cable installations, where installed in the ground.

Where subsidence is likely to occur, cables shall be installed in the ground by snaking.

Cables shall be installed without through joints where manufactured length permits. If joints are required, they must be made in an accessible position by purpose made joints of the same manufacturer as the cable.

E.25.9 Pirelli FP 200 Cables

Pirelli FP 200 cables shall comply with the requirements of BS 5266, BS 6387, and BS EN 50266. Cables shall be rated at 300/500 V and contain a full size circuit protective conductor within the cable.

Where fire resistance is required FP 200 Gold or FP Plus Gold shall be used depending upon application and degree of integrity.

The manufacturer's recommendations regarding termination and the use of special clips and supports and minimum bending radii shall be strictly observed.

E.25.10 Heat Resisting Cables

Cables used for terminations to bulkhead fittings and enclosed within tungsten luminaires shall be heat resisting with butyl rubber or silicone rubber insulation to BS EN 50525.

E.26 CABLES FOR ELV & SPECIAL APPLICATIONS

E.26.1 General

Cable types shall be verified by relevant specialist installer prior to procurement and installation. All cables shall be LSF type.

Cables shall generally be supported on and clipped to trays with final drops within plaster or wall cavity contained within PVC conduit.

Where flush socket outlets or switches are to be provided, plastic back boxes shall be installed.

Cables shall be segregated from 230/400 Volt cables either by physical barriers or by a minimum assured distance of 200 mm. Signal and Data cables shall not be routed parallel to 230/400 Volt cables.

Straight through joints shall not be made without the express permission of the Engineer except where the run length exceeds the standard drum length.

Tee joints shall only be used where indicated on the drawings.

Before installation of a joint of any type, the proposed jointing method and materials must be submitted to the Engineer for approval.

E.26.2 Telephone and Fax /Modem Cable

Telephone and Fax /Modem Cable to be PVC sheathed cable to BT Specification CW 1308 - minimum of 4 pairs.

E.26.3 Data Cable (RJ45 Outlets)

Data cable shall be UTP PVC sheathed 4 x twisted pair unscreened cable as CAT5e or CAT6 if specified and extended frequency type as supplied by RS.

E.26.4 TV/FM Signal Cable

TV/FM Signal Cables for connection between satellite dish and controller/receiver unit to be 75 Ohm coaxial CT-100/125 cable as supplied by RS.

TV/FM Signal Cables for antenna down-leads and general distribution to TV/FM outlets to be 75 Ohm coaxial M-203 low loss cable to BS EN 50117 as supplied by RS.

E.26.5 Bell Wire Cable

Bell Wire Cable to be PVC sheathed, PVC insulated 2 core cable to BS EN 50525 with stranded 0.5 mm² copper cores and rated at 3 amp.

E.26.6 Audio Speaker Cable

Audio Speaker Cable to be PVC sheathed, polyethylene insulated flat twin LC- OFC cable with 54/0.18 mm² stranded copper cores as supplied by RS.

E.26.7 Intruder Signal Cable

Intruder Signal Cable (not CCTV service) shall be PVC insulated PVC sheathed multi-core signal cable with of 7/0.2 stranded copper cores rated at 1 amp and 60volt ac. The cable shall be as supplied by RS either 4 core, 6 core or 8 core as applicable.

E.26.8 ELV Lighting Cable (12Volt to 24 Volt)

Low voltage cable between transformer and luminaire shall be by heat resistance flex supplied by the luminaire manufacturer complete with the transformer.

Flex shall be two core silicone insulated cable rated at 380/500 Volt with minimum stranded core size of 1.0 mm² with temperature rating to 180degC.

E.26.9 Fire Alarm Systems

Refer to Clause E.50 for specification requirements.

E.30 L.V. SWITCHBOARDS & SWITCHPANELS

E.30.1 General

Switchboards and Switchpanels shall be provided as indicated on the drawings and shall comprise incoming circuit protective device and switch, busbar distribution, outgoing circuit conductors and outgoing circuit protective devices complete with specified physical barriers.

Switchboards shall be site erected from suitable specified components conforming to the relevant BS and Euronorm standards for low voltage switchgear and control gear assemblies and equipment. All switchgear shall be metal clad type. The complete installation shall comply with and be site tested to BS 7671.

Switchpanels shall be factory-constructed assemblies conforming to the relevant BS and Euronorm standards for low voltage switchgear and control gear assemblies and equipment. The complete installation shall comply with and be factory tested to BS 7671.

Unless specified to the contrary, factory-constructed Switchpanels shall be provided.

All equipment shall be suitably labelled with 5mm high lettering using 'Traffolyte' or similar approved screw fixed engraved labels.

E.30.2 Switchpanels

Switchpanels shall be manufactured by Merlin Gerin to BS EN 60439-1 to Form 3 Type 2 construction with environmental protection to IP X4 or higher.

Switchpanels shall be of cubical arrangement with MCCB or ACB incomer as specified elsewhere and MCCB outgoing protection with top entry incoming cable entry and bottom exit outgoing cable exit unless otherwise specified.

Switchpanels shall be rated at 600V with copper busbars rated at 800A. The fault rating of the panel shall be a minimum of 50kA for 1 second.

Ampere and voltage meters shall be provided for the main supply to the panel.

Where specified provision shall be made for the Electricity Supply Company's current transformers test blocks and service terminations.

Panel construction shall be suitable for free standing floor-mounting arrangement employing 2mm thick high-grade steel sheet with cubical doors constructed in 1.6mm steel with 50mm integral steel plinth and the complete panel shall be finished epoxy power coat to the manufacturers standard colour.

E.30.3 Switchgear

Switchgear shall contain an integral earth bar for use in the equipotential earthing scheme.

Switchgear shall be certified by the manufacturer as suitable for the proposed installation with regard to prospect short circuit magnitude and discrimination (including discrimination against the supply authorities fuses).

E.30.4 Connections and termination of cables

Cable terminations shall be by sweated cable lugs, compression type cable lugs, clamp type terminals or thimbles. Where compression type terminals are specified, they shall be made using an approved type of cable lug and compression tool which is specifically designed for the purpose by a cable Manufacturer, and which the crimping action and pressure is automatically controlled by the tool.

Cables shall in all cases be taken direct to the terminals of the switchgear.

Pinching screws which bear directly on the conductors shall not be used on equipment having a current rating exceeding 15A. For higher ratings crimped on ferrules shall be used.

Outgoing cables shall not pass through busbar chambers unless authorised either on the Drawings or in the Schedules or in writing by the Engineer.

E.31 L.V. DISTRIBUTION EQUIPMENT

E.31.1 General

Distribution Boards shall be capable of withstanding the prospective short circuit magnitude and duration at their proposed location, fitted with 20% spare MCCB ways unless otherwise specified, fitted with manufacturers blanking plates on any unused ways, be capable of accepting the design current plus 25% unless otherwise specified, and equipped with shrouds over the incoming live terminals.

Distribution Boards shall be securely fixed to the building fabric by means of rawlbolts or other approved method, or to metal framework by means of nuts and bolts or to timberwork by brass screws.

The Contractor shall permanently and clearly label the incoming protective device and all outgoing protective and control equipment with description and rating. The contractor shall provide a plastic encapsulated A4 panel circuit schedule, which shall be fixed within each panel.

Distribution Boards shall be complete with all necessary accessory equipment as required to complete the installation of the board including, all necessary MCCBs and Switches, pan assemblies, side extension boxes, mounting kits for MCCB incomer, cable palm spreaders, cable glands, blanking plates, MCB sub-distribution assemblies, and permanent labelling and panel door lock with 2 keys.

E.31.2 MCCB Panelboards

Panelboards shall be the standard assembly arrangement as manufactured by MEM type Memshield 3 model 250 or equal and approved comprising 'J' or 'K' frame MCCB incomer depending on specified rating, with 'F' frame MCCB outgoing circuit protection.

Boards shall be manufactured to IEC 60947-2 and BS EN 60439-1 with environmental protection to IPX4. The form of separation shall be at least to Form 3B Type 2 or higher as specified.

Boards shall have a minimum busbar rating of 250A with shall be capable of accepting outgoing MCCBs of at least 125A rating as specified elsewhere.

Where specified boards shall be fitted with integral TPN and/or SPN MCB sub-distribution panels with local switch disconnector.

Where specified boards shall be fitted with the manufactures integral ampere and voltage meter pack.

MCCBs shall be Memshield 3 Standard or Hi-Break SP, DP, TP, or FP types as specified and shall comply with IEC 60947-2 and be suitable for 35mm din rail mounting.

MCBs shall be Memshield 3 SP, DP, TP or FP and types B, C, or D as specified and shall comply with BS EN 60898 and BS EN 60947-2 and suitable for standard din rail mounting.

E.31.3 MCB Distribution Panels

Distribution Panels shall be the standard assembly arrangement as manufactured by MEM type Memshield 3 or Merlin Gerin type Isobar 4 or equal and approved.

Type A panels for SPN applications shall be provided with 125A rated busbars and suitable for incoming protective and switching devices rated up to 100A.

Type B panels for TPN applications shall be provided with 250A rated bus bars and suitable for incoming protective and switching devices rated up to 200A. Where SPN panels are specified with more than 16 outgoing ways, Type B panels shall be employed complete with the manufacturers single phase kit.

Panels shall be manufactured to BS 5486 and BS EN 60439-3 with environmental protection to IPX4. The form of separation shall be at least to Form 3B Type 2 or higher as specified.

All small power and all lighting circuits shall be protected by means of RCD (RCCDs or RCBO) devices having 30mmA trip rating. Unless otherwise specified, other circuits shall be protected by Type B MCB devices.

MCBs and RCBOs shall be as manufactured by the panel manufacturer and be SP, DP, TP or FP and types B, C, or D as specified and shall comply with BS EN 60898 and BS EN 60947-2 and suitable for standard 35mm din rail mounting.

E.31.4 MCB Consumer Units (Residential)

Where Consumer Units are specifically specified, these shall comprise an integrated unit within a single casing with one or more main switch disconnector and individually MCB/RCBO protected outgoing circuit ways and shall be as manufactured by MK type Sentry or equal and approved.

Consumer Units shall be recessed or surface type as specified and the enclosure shall be either plastic or steel as specified. Unless specified to the contrary Consumer Units shall be recess steel enclosure type. The Consumer Unit shall be provided with clear Perspex access door for access to Main Switch and Circuit Modules.

RCBO protection with 30mA trip current rating shall be provided for all lighting and small power outgoing ways. Other circuits may be protected with either MCB or RCBO devices in accordance with BS 7671.

Consumer Units shall be located within 1.0m of the main electrical supply entry position to the Residential Unit and in a convenient position for access and maintenance and at a mounting height of 1200mm.

Consumer Units shall be manufactured to comply with BS 5486 and BS EN 60439 and be capable of withstanding the prospective short circuit magnitude and duration at their proposed location. Busbar rating shall be 100A minimum.

The unit shall have colour-coded neutral and earth terminal bars with numbered terminals to correspond with the number of outgoing modules.

Access to the panel wiring, bus bars and earth and neutral terminal bars shall be by removal of the screw fixed front facia panel. Within the panel, the phase busbars and live terminal screws shall be fully shrouded.

The unit shall be suitable for modular clip-on din rail mounted circuit devices including MCBs, RCBOs, Contactors, Timers and Door Bell Transformers.

Each unit shall be fitted with 20% spare MCBs unless otherwise specified, fitted with manufacturers blanking plates on any unused ways and equipped with shrouds over the incoming live terminals.

Unless otherwise stated each Consumer Unit shall be complete with 100A Switch Disconnector and be suitable for at least 12 modular devices including Switch Disconnector. The unit shall be complete with all necessary modules as required. Where specified, split load Consumer Units suitable for two or more incoming supplies shall be provided.

Cable entry/exit shall be by knock-outs located on 4 sides and rear of enclosure. Correctly sized grommets shall be provided at each cable entry. Any un-used 'open' knock-outs shall be protected by blind grommets.

MCBs and RCBOs shall be as manufactured by the panel manufacturer and be SP, DP, TP or FP and types B, C, or D as specified and shall comply with BS EN 60898 and BS EN 60947-2 and suitable for standard 35mm din rail mounting.

E.40 LIGHTING SERVICES

E.40.1 General

Lighting installations shall include general lighting services, feature lighting, external utility and feature lighting, emergency escape lighting, illuminated escape signage and all associated control and switching.

All installations shall be in accordance with BS 7671 and luminaries shall be correctly IP rated for the environment.

Where appropriate luminaries shall be in accordance with CIBSE LG3 or other approved standard. All lighting circuits shall be radial arrangement and all circuits shall be protected by 30mA RCD in addition to over-current protection.

Unless otherwise stated all luminaires shall be designed to accept low energy lamps able to provide at least 45 lumen/Watt light output.

E.40.1 Ceiling Roses

Ceiling roses shall be white plastic to BS 67. Roses shall be fitted with integral enclosure and earthing plate or connection to comply with BS 7671 and be 4 terminal type suitable for loop-in wiring.

Where luminaires are surfaced fixed to false ceilings or are recessed into false ceilings roses shall be of the 'rock rose' plug and socket outlet type.

E.40.2 Lampholders

Lampholders for 230 volt circuits shall be manufactured in accordance with BS 5042 and BS 5101 and where used with pendant fittings shall incorporate compression cord grips.

Lampholders for GLS lamps shall be BC or ES type. ES type shall be fitted with porcelain interiors.

Where ES type is integral with light fittings lampholders shall be brass with ceramic interiors.

Where for use with 2D and PL type fluorescent lamps lampholders shall be white plastic construction 2 pin or 4 pin as appropriate.

For external use and for use in bathrooms/shower rooms, 230V lampholders shall fully enclosed within the fitting and have a protection rating in accordance with BS 7671.

E.40.3 Pendant and Soffit Fixed Luminaires

Pendant fittings shall be suspended from Ceiling Roses. The contractor shall ensure the fixing of the rose and the grade of the flex is suitable for the weight of the fitting.

Where surface fixed luminaire is to be fixed to a concrete soffit this shall be by plug and screw fixings in accordance with the manufacturers recommendations. Where surface fixed luminaire is to be fixed to a plaster joisted ceiling this shall be by screw fixings direct to the joist or in the case where a joist is not available, the Contractor shall fix a suitable timber cross batten within the ceiling void to accept the fixing screws. The Contractor shall not rely on plasterboard or expanding toggle type fixings for ceiling fittings. Fixing screws shall be brass.

E.40.4 Wall Fixed Luminaires

The circuit wiring shall terminate with a 10A rated plastic strip connector within a suitable recessed 35mm deep pvc or galvanised back box or conduit BESA box which shall be securely fixed back to the structure.

The Contractor shall extend the luminaire flex cable from the connector and fix the luminaire either by fixing screws directly to the back box/BESA box or by plug and screw to the wall depending upon luminaire fixing centres. Fixing screws shall be brass.

E.40.5 External Luminaires Fixed to Building

All external luminaires shall be IP65 rated. The luminaire manufacturer's installation instructions shall be followed to maintain required protection to BS 7671. Fixing screws shall be brass.

E.40.6 Luminaires and Lamps

Luminaires shall be supplied and fixed under this Contract. Luminaires shall be complete with lamps, control gear, fixing/suspension equipment, and specified louvres/lens.

The Contractor shall allow for first, second and final fix of internal luminaires to suit the Main Contractor's program. Final fix, which shall not be undertaken until all construction and dirty work has been completed shall include lamping and fixing louvre/lense. Prior to final fix, luminaires shall be protected.

Where IP protection ratings are specified, the Contractor shall ensure that the manufacturer's instructions are followed regarding method of luminaire fixing, cable entry arrangement, and provision of gaskets or sealants.

All luminaires installed in shower rooms, bathrooms shall be provided with supplementary bonding unless specified as being double insulated.

Where the installation of a recessed luminaire requires penetration through a fire rating ceiling or bulkhead, the Contractor shall allow for the supply and installation of a purpose designed fire rated enclosure to contain the fitting and to seal to the ceiling/bulkhead to maintain the integrity of the fire rating of the ceiling/bulkhead.

Luminaires with tube suspensions shall be fitted with non-rigid joints of the ball and socket type, which shall be provided with an earth connection independent of the ball joint.

All luminaires shall be manufactured to relevant British Standards. Fluorescent luminaires shall have control gear complying with BS EN 60155.

The Electrical Contractor shall submit, with his tender, full schedules of the proposed luminaires for each area of the building giving details of the manufacturer, model/type, wattage, lamp details and manufacturer's illustration including axial and transverse polar data.

The Electrical Contractor shall allow in this Tender Price for the supply and fitting of all lamps to the wattage, colour and type as necessary to meet the requirements of this Technical Specification, the Schedules and the Design Drawings prepared by the Engineer.

Fluorescent luminaires shall be complete with high frequency power factor corrected control gear with a minimum lagging power factor of 0.95.

E.40.7 Lighting Switches

Lighting Switches shall be as specified elsewhere, and shall be as manufactured in accordance with BS 3676 and BS EN 60669 by MK, Crabtree, Wandsworth or equal, and installed in the positions specified. Switches shall be 20A rated double pole, two way or intermediate type as appropriate.

Switches shall be positioned 1000 above floor level.

One to three gang On/Off switches shall be of the plateswitch type with single gang plate. Four to six gang On/Off switches shall be of the plateswitch type with double gang plate. Grid switches shall be used for more than six gang On/Off switches in one group.

Recessed switches shall be mounted in minimum 25mm deep galvanised boxes fitted with adjustable grids to allow for variations in the thickness of plastered walls. Where installed in 'Dryline' walls, plastic dry lining recessed boxed shall be used.

Where specified surface switches shall be used. These shall be metal clad type for use in garages and workrooms and plastic in storerooms, and loft spaces. Surface switches shall be complete the manufacturers recommended surface box. All cable entries to be by knock-outs with grommets provided for metal boxes.

If more than one phase is to be connected to a multi-gang switch, the Contractor shall use a grid switch system with phase barriers and in addition provide a 'Danger 400 Volt' sign within the box.

E.40.8 PIR Lighting Switching

Where indicated on the drawings Passive Infrared detectors shall be provided to switch local lighting circuits within bathrooms, cloakrooms, WCs and wardrobes and cupboards.

PIRs shall be either ceiling or side-wall mounted as required and shall be positioned to ensure correct operation with the avoidance of nuisance triggering.

PIR devices shall be as manufactured by CP Electronics.

In bathrooms and external areas PIRs shall be IP55 rated.

For general application of on/off switching 230v lighting circuits, PIRs shall be type EBDS PIR.

For applications of on/off switching 230v lighting circuits where sensitivity adjustment is required such as wardrobes and cupboards, PIRs shall be type EBDS PIR-PRM complete with hand programmer.

PIRs for switching Extra Low Voltage circuits (12v to 24v) where volt free switching is required shall be type EBDS PIR24V-VFC.

For switching dimming circuits, PIRs shall be type EBDS-DD or EBDS-AD as appropriate.

E.40.9 Dimming Controls

E.40.9.1 Local Dimmer Switches

Where specified, the Contractor shall provide local electronic lighting dimmers incorporated into the lighting switch unit.

Incandescent dimmers shall be suitable for dimming 230V and 12V tungsten lighting rated at a minimum of 300VA for switched circuit.

Fluorescent and LED dimmers shall be suitable for 0-10v control and shall be suitable for the type of load and for the luminaire control system.

Where the requirement is for 2 gang dimming in one group this shall be by double dimmer switch on a single gang plate. For more than two dimming circuits in one group, a grid switch arrangement shall be used.

Remote dimming units shall be used for lighting circuit loads over 500VA per circuit and for dimming all fluorescent loads.

E.40.9.2 Remote and Centralized Dimmers

Where specified, the Contractor shall provide electronic lighting dimmer systems which shall comprise lighting control switch and compatible remote dimming equipment which shall be suitable for the circuit loading and luminaire types. The installation shall include control cables between switch and control equipment.

High power remote single circuit dimmers shall be provided to control specific lighting circuits which exceed the loading of dimmer switches as E.10.8.1 which shall generally be applicable for circuits rated at 500VA and above.

Local Room Dimming Systems shall be of the zonal type as Lutron Grafik Eye or equal approved designed to control a number of different lighting circuits in the same room/zone. The system shall be capable of controlling LED, fluorescent and tungsten circuits. The system shall be complete with compatible User control plates finished to match requirements of electrical accessories.

Centralized dimming systems shall be of the centralised rack type as Lutron Home Works or equal approved capable of controlling a number of lighting circuits in a number of rooms/zones. The system shall be capable of controlling LED, fluorescent and tungsten circuits. The system shall be complete with compatible User control plates finished to match requirements of electrical accessories.

Centralized dimming systems shall be commissioned by the system supplier or his approved agent. In the case of Lutron systems, the Contractor shall include for initial setting up of the systems and for a subsequent final commissioning and adjustment after the building is occupied.

E.40.10 Installation Of Low Voltage Luminaires

E.40.10.1 Wiring to Low Voltage Tungsten and LED Luminaires

Low voltage luminaires with individual transformers/drivers shall be connected directly to the 230 Volt switched lighting circuit via heat resistant flex which shall be of minimum length of 3.0 m.

Low voltage cable between transformer/driver and luminaire shall be by heat resistance flex supplied by the luminaire manufacturer complete with the transformer. Where necessary MK 913 BRO or equivalent shall be used to interconnect PVC cable with heat resisting flex.

E.40.10.2 Common Transformers/Drivers (LED)

Low voltage luminaire which share a common transformer/driver shall be fed by cables of identical lengths from a common terminal block. Cables shall in no case be more that 5m long. If the transformer has a multi-way terminal block, each luminaire must be wired directly to it, no series connection shall be permitted.

The transformer/driver shall be of the regulated type to ensure that lamp failure shall not result in over voltage on other low voltage circuits.

If the transformer/driver has no multi-way terminal block, the low voltage supply shall be divided by means of an MK 1132 BRO or equivalent. Such divider shall be located directly adjacent to the transformers/drivers.

E.40.10.3 Maximum Permitted cable lengths

The following cable lengths shall not be exceeded:

a) Lamps fed from individual transformers

Lamp	**1.0mm²**	**1.5mm²**	**2.5mm²**
20W	2.5m	12.8m	21.1m
50W	3.4m	5.1m	8.4m
70W	2.2m	3.4m	5.6m

b) Lamps fed from Common Transformers

Lamp	**1.0mm²**	**1.5mm²**	**2.5mm²**
20W	5.8m	8.7m	14.3m
50W	2.3m	3.4m	5.7m
70W	1.5m	2.3m	3.8m

E.40.10.4 Installation of Transformers

Transformers shall be wire wound regulated type complete with thermal over-load and auto reset and shall be matched to suit the maximum lamp ratings. Transformer shall be located in suitable accessible ventilated areas. Where transformer are to be located within ceiling voids, the Contractor shall ensure there is sufficient ventilation and that there is no combustible materials in the vicinity of the transformer including unprotected cables.

Where transformers serve a single luminaire and are of the torpedo in-line type and access is via the luminaire fixing hole, the Contractor shall take special measures to ensure that when the transformer is re-inserted through the fixing hole, the transformer cannot not come into close contact with combustible materials including unprotected cables.

E.40.10.5 Installation of LED Drivers

Drivers shall be of the solid-state electronic type and shall be supplied by the luminaire manufacturer/supplier and rated for use with the relevant luminaires. Drivers shall be provided and installed to serve a specific number and specification of LED luminaires in accordance with the manufacturers requirements.

Drivers shall be installed in appropriate environments. Where installed externally or in damp environments suitable IP rated enclosures shall be provided

Driver shall be located in suitable accessible ventilated areas.

E.40.11 Emergency Escape Lighting

Not Applicable

E.40.12 Illuminated Escape Signage

Not Applicable

E.40.13 Additional Requirements for Lighting in Bathrooms and Shower Rooms

The Contractor shall comply with the requirements of BS 7671.

Luminaires in Zone 0 shall be IPX7/X8 rated and shall be maximum 12v operating voltage.

Luminaires in Zone1 shall be IPX5 rated and shall be maximum 12v operating voltage.

Luminaires in Zones 2 shall be IPX4 rated either 12v or RCD (30mA) protected. IPX5 shall be used where water jets likely to be used for cleaning purposes.

No 230v light switches shall be located in Zones 0, 1, 2, and 3.

Pull-cord switches shall be permitted in Zone 2 and 3 (body of switch outside Zones 1 and 2) subject to BS 7671 requirements.

E.41 SMALL POWER SERVICES

E.41.1 Small Power Circuits

Where specified, a complete installation for small power shall be provided. Except for external services and services within plant rooms and stores, all small power installations shall be fully recessed with flush fixed accessories.

Cabled circuits shall be extended from Distribution Boards to provide ring main or radial circuits to connect to socket outlets and/or fused connection units as required.

Ring Main circuits shall be wired in cable of minimum size 2.5mm2 + 1.5mm2 CPC and be protected by 32A MCB + 30mmA RCD or by 32A 30mmA RCBO device and one Ring circuit shall serve an area not exceeding 50m2.

Radial circuits shall be wired in cable of minimum size 4.0 mm2 + 1.5mm2 CPC and be protected by 32A MCB + 30mmA RCD or by 32A 30mmA RCBO device and one Radial circuit shall serve an area not exceeding 20m2.

All socket outlets within the same room or space shall be on the same phase and this shall match, wherever possible, the phase of the lighting services in the same area.

All wall mounted socket outlets and fused connection units shall be located within the zone of 450mm to 1200mm above floor level and as set dimensionally out on the Architects Drawings.

Adequate surface metal clad switched double socket outlets shall be provided in garages, plant rooms and areas designated for storage and workshop purposes.

Socket outlets shall be manufactured in accordance with BS 1363 type MK, Crabtree, Wandsworth, or equal for small power socket outlets and mounted in multi-assemblies where grouped.

E.41.2 Cooker Control Circuit

A complete installation for power to electric cookers shall be provided. A cabled circuit shall be extended from the Distribution Board to provide a radial power circuit to connect to each cooker position as required.

Each radial circuit shall be run in twin and earth cable of minimum size 6.0mm2 + 2.5mm2 CPC and be protected by 40A Type B MCB device. For cookers rated over 40A, the supply cable shall be of minimum size 10mm2 + 4mm2 CPC and be protected by 45A Type B MCB device.

The circuit shall terminate with a recessed 45A rated double pole Cooker Control with switch and neon to BS 3676 and BS EN 60669 without switchsocket. The final connection from the Cooker Control to the cooker shall be recessed hardwired service to recessed Cooker Connection Unit located adjacent to the cooker with final connection run in heat resisting flex.

In addition cookers with all gas or part gas cooking shall be provided with a 13A fused connection unit wired off the kitchen ring main circuit to provide electrical supply for the ignition circuits.

E.41.3 Immersion Heater Circuit - Not exceeding 3kW Loading

A complete installation for power to electric immersion heaters shall be provided. A cabled circuit shall be extended from the Distribution Board to provide a radial power circuit to connect to each heater as required.

Each radial circuit shall be run in twin and earth cable of minimum size 2.5mm2 + 1.5mm2 CPC and be protected by 16A Type B MCB device and 30mA RCD.

The circuit shall terminate with a surface mounted 20A rated double pole switch with neon to BS 3676 and BS EN 60669 and front flex outlet. The final connection from the dp switch the heater shall be run in heat resisting flex.

E.41.4 Electric Shower Circuit – Not exceeding 10kW Loading

Not Applicable

E.41.5 Central Heating Boiler Circuit (Domestic Installations)

Not Applicable

E.41.6 Electrical Supply to Smoke Alarm/Fire Alarm Circuit (Domestic Installations)

A complete installation for power to the Smoke Detectors/Fire Alarm shall be provided. A dedicated cabled circuit shall be extended from the Distribution Board to provide a radial power circuit to connect to the smoke detectors as required.

Each radial circuit shall be run in twin and earth cable of minimum size 1.5mm2 + 1.0m2 CPC and be protected by 6A Type B MCB device.

The circuit shall terminate with a junction box located near to the detector. The final connection from the junction box to the detector shall be made using the wired-in flex supplied with the detector.

Where the installation requires more than one smoke alarm unit, the contractor shall run a 1.5mm 3core + earth sheathed PVC cable to run and connect between each smoke alarm unit in accordance with the manufacturer's instructions.

E.41.7 Electric Towel Rails – Not exceeding 1.0kW Loading/Heater

Where required a complete installation for power to electric towel rails shall be provided. A cabled circuit shall be extended from the Distribution Board to provide a radial power circuit to connect to each towel rail position as required.

Where specified towel rail supplies shall be time switched with timers located within the Consumer Unit.

The radial circuit shall be run in twin and earth cable of minimum size 2.5mm2 + 1.5mm2 CPC and be protected by 16A Type B MCB device and 30mA RCD.

The circuit shall terminate with a recessed 13A switched fused connection unit with neon located outside of the bathroom/shower room. The final connection from the fused connection unit shall be recessed hardwired service to recessed IPX5 Flex Outlet Frontplate located adjacent to the towel rail. The final connection from the flex outlet to the towel rail shall be made using the wired-in flex supplied with the towel rail.

E.41.8 Electric Space Heaters - Not exceeding 3kW Loading/Heater

Not Applicable

E.41.9 Supplies to Door Bell Transformer

The supply may be taken directly from a 3A MCB protected outgoing way at the Consumer Unit or extended by means of a fused connection unit on a small power ring fused down to 3A. The transformer shall be 230V/8V and can be located either within the Consumer unit or in a suitable position within the dwelling. The 230V supply to the transformer shall be run in twin and earth cable of minimum size 1.5mm2 + 1.0mm2 CPC.

E.41.10 Supplies to Door Entry and Similar Low Power Systems

The supply may be taken directly from a 3A MCB protected outgoing way at the Consumer Unit or extended by means of a fused connection unit on a small power ring fused down to 3A. The 230V supply to the door entry system shall be run in twin and earth cable of minimum size 1.5mm2 + 1.0mm2 CPC.

E.41.11 Supplies to Bathroom Ventilation Fans (controlled by Lighting Switch or PIR)

Where specified, bathroom extractor fans shall be wired from the local lighting circuit and provided with both switched and un-switched phase connections as required for fan run-on timer operation. The switched line shall be either controlled by the lighting switch or by PIR as specified.

Where the lighting circuit over-current protection is rated at 10A or greater, suitable additional fused connection units shall be installed in the supplies to the fan.

A suitable 3 pole fan isolation maintenance switch shall be provided to break the switched, un-switched and neutral connections to each fan. The location of the maintenance switch shall be agreed with Architect.

E.41.12 Additional Requirements for Small Power Services in Bathrooms and Shower Rooms

The Contractor shall comply with the requirements of BS 7671.

No electrical equipment shall be installed in Zone 0.

Fixed equipment may be permitted in Zone 1 and 2 subject to BS 7671, subject to suitability for location and subject to protection by RCD (30mA).

No socket outlets or switches shall be permitted in Zone 0, 1, and 2.

Pull-cord switches shall be permitted in Zone 2 (body of switch outside Zone 2) subject to BS 7671 requirements.

E.41.14 Floor Boxes

Not Applicable

E.50 FIRE DETECTION & ALARM SYSTEMS – PERFORMANCE SPECIFICATION

E.50.1 General

This specification for Fire Detection & Alarm Systems is a Performance Specification and the Services Contractor shall engage a suitable Specialist to design install and test this system in accordance with the following requirements.

Two levels of specification are provided as detailed under E.50.2 and E.50.3.

Generally a fully monitored automatic system to BS 5839 as E.50.2 shall be provided and this shall be suitable for all commercial applications, hotels, restaurants/kitchens, educational buildings, "large houses" (as defined in Building Regulations Part B – that is any residential unit of 2 stories or more and where any one storey has a floor area of 200m2 or more), sheltered housing units, HMSOs, apartment blocks and multi-residential developments with common access and circulation, health and nursing care buildings, public buildings, assembly buildings, retail and warehouse applications and hostels/dormitories and all other applications as required under BS 5839.

Small single residential units such as houses and apartments without common access and circulation areas shall, if specified, be provided with a non-monitored smoke detection and alarm system as E.50.3 and as Building Regulations Part B for "Dwelling Houses" as BS 5839 Category LD1 Grade C/D.

E.50.2 Automatic Monitored System to BS 5839

Not Applicable

E.50.2.1 Control & Indication Equipment (CIE)

Not Applicable

E.50.2.2 Fire Sensors

Not Applicable

E.50.2.3 Manual Call Points

Not Applicable

E.50.2.4 Warning Beacons

Not Applicable

E.50.2.5 Power Supplies

The normal power to the system supply shall be by a dedicated single phase 230V radial circuit extended directly from the Main Electrical Distribution Panel (that is the distribution panel nearest to the origin of the mains supply to the building), which shall terminate in a suitable double pole isolator adjacent to the CIE panel. The isolator shall be labelled **"FIRE ALARM - DO NOT SWITCH OFF"**

The normal supply shall be protected at the origin of the circuit by a suitably rated over current protection device which shall be colour coded red and labelled **"FIRE ALARM - DO NOT SWITCH OFF"**

A suitable emergency standby power supply shall be provided by means of rechargeable batteries and trickle charger, which shall be integral with the CIE. The batteries shall be maintained in a fully charged condition by regulated voltage converter through the mains supply. The batteries shall be rated to maintain the system in full operation for a minimum period of 24 hours, after which time sufficient battery capacity shall remain to provide an 'Evacuate' signal in all zones for at least 30 minutes. Batteries shall have a rated life of not less than 4 years.

E.50.2.6 Cables

Wiring to the fire alarm system including power supplies shall be segregated from all other services.

Wiring of Power supplies, alarm sounder circuits and detector/call-point circuits shall be carried out in accordance with BS 5839 – Clause 26. Cables, cable jointing, and cable supports and fixings shall be rated for 'Enhanced' application and shall achieve PH120 classification when tested to EN 50020.

Cables shall have a minimum conductor cross-sectional area of 1.5mm2 and shall be coloured RED.

Cables shall be one of the following types:

MICC cable with an overall polymeric covering to conform to BS EN 60702-1
Cables to conform to BS 7629 or BS 7846
Cables rated at 300/500V that provide the same degree of safety as that afforded by compliance with BS 7629
Pirelli FP Plus with Pirelli FP Firefix fixings/supports

E.50.2.7 Testing, Commissioning and FO Approval

The Contractor shall carry out and document all recommended actions in accordance with BS 5839 – Clauses 38 and 39.

On successful completion of the commissioning works, the contractor shall arrange with the relevant Local Authority for the Building Control Officer or the Fire Officer as appropriate, to attend site to inspect the completed installation and to witness the operation of the system. The Contractor shall obtain the approval of the Building Control Officer or Fire officer in writing and this shall form part of the system Record Information

E.50.2.8. Record Information

The Contractor shall provide an Operation and Maintenance Manual for the complete installation, which shall include a full set of Record Drawings detailing the installation. The manual shall be as generally described under Section B of the Specification.

In addition the Contractor shall provide 3 sets of A3 Fire and Safety Schematic Drawings as required by the 1971 Fire Precautions Act, which shall be suitable for adoption by the relevant Fire Authority.

E.50.2.9 Certification, Acceptance and Hand-Over

Immediately on completion of the installation and commissioning of the system, the Contractor shall provide three sets of full certification documentation in accordance with BS 5839 - Clause 41.

The Contractor shall carry out and document all recommended actions in connection with BS 5839 - Clause 42 including demonstration of the system and the issue of all required documentation and record information which shall include a full explanation of the operation of the system and guidance on the interpretation of the Record Drawings and Documentation.

The Contractor shall advise the Building Owner/User on the requirements under BS 5839 regarding maintenance of the system.

The Contractor shall, in conjunction with the Engineer, arrange and attend a meeting with the Building Owner/User to formally hand the system over in accordance with BS 5839 – Clause 42.

E.50.3 Performance Specification for Residential (Single Unit) Applications

The installation shall be an accordance with Building Regulations Part B for “Dwelling Houses” and shall be in accordance with BS 5839 Category LD1 minimum Grade D.

Where specified, the fire alarm system for residential applications and where the property is not classified as a ‘Large House’ under Approved Document B1, and where the residential unit is not part of sheltered accommodation, the installation shall comprise a smoke detection system with integral sounders.

A 230v Mains Smoke Alarm unit shall be located in the circulation area at each level of accommodation in accordance with Building Regulations and in addition a detector shall be located in the kitchen and in each bedroom. Smoke Alarms shall be complete with battery back-up, and low battery audible alarm

Where two or more smoke alarm units are provided within a premises these shall be electrically interlinked such that activation of any one smoke alarm unit shall activate all other smoke alarm units in the premises.

Each detector/sounders shall be provided with test facility which when activated shall cause all detectors to go to alarm condition.

The detector sounders shall be wired directly from the main distribution panel (consumer unit) by means of a dedicated circuit which shall be clearly labelled “SMOKE DETECTOR CIRCUIT” at the panel.

For residential applications with enclosed common circulation and access and escape routes serve more than one residential unit, a fully automatic centralised Fire Alarm and Detection System to BS 5839 shall be provided to protect the common circulation and escape routes as detailed under Clauses E.50.2.

E.50.3.1 Testing, Commissioning and FO Approval

The Contractor shall carry out and document all recommended actions in accordance with BS 5839.

On successful completion of the commissioning works, the contractor shall arrange with the relevant Local Authority for the Building Control Officer or the Fire Officer as appropriate, to attend site to inspect the completed installation and to witness the operation of the system. The Contractor shall obtain the approval of the Building Control Officer or Fire officer in writing and this shall form part of the system Record Information

E.50.3.2 Record Information

The Contractor shall provide an Operation and Maintenance Manual for the complete installation, which shall include a full set of Record Drawings detailing the installation. The manual shall be as generally described under Section B of the Specification.

E.50.3.3 Certification, Acceptance and Hand-Over

Immediately on completion of the installation and commissioning of the system, the Contractor shall provide three sets of full certification documentation in accordance with BS 5839.

The Contractor shall carry out and document all recommended actions in connection with BS 5839 including demonstration of the system and the issue of all required documentation and record information which shall include a full explanation of the operation of the system and guidance on the interpretation of the Record Drawings and Documentation.

The Contractor shall advise the Building Owner/User on the requirements under BS 5839 regarding maintenance of the system.

E.51 CARBON MONOXIDE (CO) DETECTION & ALARM

CO monitor/alarm units shall be provided where specified and in any case within all rooms containing solid fuel burning appliances and in all bedrooms/dormitories/designated sleeping areas within any building which contains a solid fuel burning appliance in accordance with BS EN 50291.

The CO monitor/alarm units shall be 230V mains powered with integral battery back-up, with integral sounders and with inbuilt audible warning of low battery charge.

CO monitor/alarm units shall be positioned on the ceiling or at high level on walls.

The CO monitor/alarm units shall be manufactured and deployed in accordance with BS EN 50291.

E.52 INTRUDER DETECTION & ALARM SYSTEMS

E.52.1 General

Where specified a complete intruder detection and alarm system shall be installed. The Security Systems shall be designed and installed by a suitable specialist who shall be experienced with this type of installation and with installations within the highest quality of residential developments. The installer shall be a registered NACOSS and NICEIC registered Contractor.

The installation shall be in accordance with BS 4737 and BS EN 50131 as appropriate. The completed installation shall be in accordance all requirements and recommendations of NACOSS. All associated electrical installations shall be in accordance with BS 7671.

The installing specialist shall be a domestic sub-contractor to the Contractor.

The installing specialist shall be responsible for ensuring the performance of the Security System, which shall be to highest standards of performance and shall meet the requirements of this Performance Specification and the Employer's Insurers.

The installing specialist shall coordinate the installation of wiring services with the installation of other services including cabled, piped and ducted services.

All cables other than the final short flex connections to external CCTV cameras and external security lighting shall be concealed from view. All concealed cables shall be protected within conduit and trunking which shall be installed as part of these works.

The installation shall be complete with all necessary components and interconnect cabling for the complete and proper functioning of the Security System.

The installation shall be to the highest quality, with all work carried out to the highest trade standards with particular attention being paid to neatness, and to ensuring a very unobtrusive appearance.

The specialist installer shall take full responsibility for the siting and performance of each component and shall, prior to commencement of the installations, produce dimensioned layout drawings indicating the location of all equipment and the routing of all cabled services. These drawings shall be issued to the Architect for comments.

Prior to installation, the installer shall provide samples of each component to be installed for consideration by the Architect. Where appropriate, the installer is to offer alternatives for consideration by the Architect. The adoption of alternative components and/or locations as agreed by the installer, shall in no way compromise the performance of the installation.

The installer shall provide a one-year parts and labour warranty on the complete installation to commence when the building project receives Practical Completion Certification from the Architect.

The installation shall include the costs of comprehensive maintenance of the installation for the first year including all call outs necessitated by system or component malfunction.

On completion of the installation and prior to Practical Completion, the installer shall allow for a complete test of all aspects of the installation over a period of one week. Tests shall be witnessed by the Architect and Test Certificates shall be provided by the Installer.

Prior to Practical Completion, the Installer shall provide complete sets of Record Drawings, which shall detail all aspects of the installation including equipment and cable routes.

Prior to Practical Completion, the Installer shall provide Operating and Maintenance Manuals, which shall describe the operation of the security systems and shall include the manufacturer's details of all items of installed equipment.

Following Practical Completion, the installer shall provide a full days on site training for the Employer and/or the staff, on the manner of operation of the various security systems and on procedures in the event of faults and security alerts.

Installer shall provide a guarantee of service response following any notification of malfunction with a maximum response time of 4 hours between contact and the arrival of service engineers on site. The installer shall also provide a guarantee of maximum system down time of 12 hours following notification of a malfunction.

E.52.2 Intruder Detection

The scope of the Security System shall be as indicated on the Drawings and/or elsewhere in this Specification.

System components shall be designed and installed in a coordinated manner such that each element of the installation operates in conjunction with each of the other elements to provide a fully integrated security installation. The installations shall be complete with all necessary wiring installations.

Unless otherwise stated the minimum performance requirement shall equal or exceed EN 50131 Grade 3 (Medium to High Risk) and all internal components shall be to Class 2 and all external components shall be to Class4. Power supply requirements shall be Type A with supply comprising mains electricity and rechargeable batteries with at least standby power capacity.

As a minimum standard each system shall comprise door contact on final exit door, PIR movement detectors, set/unset keypads, external sirens, internal audible alarms, and main panel incorporating auto dial-up communicator. In addition vibration detection may be additionally required to monitor windows, doors and rooflights and additional door contacts may be required on secondary exit doors.

As a minimum requirement each system shall comprise PIR detection to cover intrusion by any downstairs window, internal entrance/lobby areas, with PIR protection to cover the stair and upper floor landings. Where specified additional PIR cover shall be provided to other areas.

Door contacts shall be suitable for the installed door/frame arrangement and shall be of the type recessed into the door top edge.

PIR detectors shall be located at high level in suitably discrete positions to be agreed with the Architect. PIR shall be double knock type with anti-crepe detection and shall have a spread and throw to suit application but without giving rise to nuisance trips created by legitimate external activity.

The internal audible alarm unit shall be located in accordance with the Architects/Users requirements but in any case shall be sufficiently close to the keypad and final exit door to ensure satisfactory operation.

The external siren shall be complete with integral fail-safe batteries and illuminated beacon and shall be located in accordance with the Architects requirements subject to the position being visible and safe from vandalism.

Keypads shall be located at a convenient height to suit the Architects requirements in the range of 1000mm to 1200mm above floor level with additional key pad located for disabled access. Keypads shall be positioned in a well-lit and easily accessed area and within audible range of the internal sounder. The keypad shall be of the permanently backlit LCD type with alpha/numeric entry pad.

The main panel shall be located in a suitable store/cupboard to be agreed with the user and shall be complete with standby batter pack and trickle charger with rated capacity to provide 24-hour operation in event of mains failure and complete with anti-tamper protection. The system shall allow for at least 64 reprogrammable entry codes and these shall be capable of grouping under a security hierarchy. The system shall be capable of part set operation.

E.52.3 Closed Circuit Television Surveillance (CCTV)

Where specified and as indicated on the drawings CCTV surveillance shall be provided. Cameras shall be positioned general as indicated on the drawings but final location shall be subject to agreement between the specialist installer and the Architect.

External cameras shall be mini-dome type housed with IP64 housings. Cameras shall be HD high resolution suitable for low light operation with auto change over from colour to monochrome in low light conditions. Unless otherwise stated, cameras shall be fixed focal length type without panning facility (not TPZ).

Cameras shall be either 230v with separate video signal cable or low voltage type powered through multicore cable connection to suit location and application.

The CCTV video signal shall be arranged to feed into the A/V system for monitoring on TV sets and on video door entry monitors as appropriate.

A suitable dedicated HD hard disk recorder with at least 8 channels shall be provided to capture and record all CCTV video information which shall have at least 2TGB storage to provide a minimum of 30 day recording with automatic over-write of outdated data. The recorder shall time stamp all video images. HDD back up shall be provided by means of USB computer/external HDD interface.

E.53 HEALTH & SAFETY DISTRESS ALARMS

The Contractor shall provide an alarm system in accordance with Building Regulations Part M within all toilets, Shower Rooms and Bedrooms designated for use by physically handicapped people. The system shall provide a call point within the room identified by RED triangle or other approved indicator. A visual alarm beacon and sounder shall be positioned immediately outside of the room in a prominent position with a repeater warning light and sounder located at an agreed position such as the Reception. A touch sensitive cancel button shall be provided within the room. A battery back of minimum 3-hour capacity shall be provided to ensure the system is fully operative in the event of a power failure.

E.54 DISABLED REFUGE ALARM AND COMMUNICATION SERVICES

Not Applicable

SECTION F MECHANICAL SERVICES SPECIFICATION

F1 PIPEWORK, WATER STORAGE & ASSOCIATED EQUIPMENT
F.10 PRIMARY WATER & GAS PIPEWORK DISTRIBUTION
F.11 PIPEWORK
F.12 PIPEWORK SYSTEM TREATMENT
F.13 PIPEWORK EXPANSION DEVICES
F.14 VALVES & STRAINERS
F.15 WATER CONDITIONING, FILTRATION, STERILISATION AND SOFTENING EQUIPMENT
F.16 TANKS & CISTERNS

F2 VENTILATION SERVICES
F.20 DUCTWORK
F.24 DUCT-LINE MOUNTED EXTRACT FANS
F.28 TOILET, BATHROOM & KITCHEN EXTRACTOR UNITS

F3 THERMAL INSULATION
F.30 THERMAL INSULATION

F4 HEAT GENERATING EQUIPMENT AND ASSOCIATED SERVICES
F.43 HEAT PUMP PLANT - FOR HEATING AND COOLING DUTY
F.46 FEED & EXPANSION EQUIPMENT

F5 NOT ISSUED

F6 NOT ISSUED

F7 HEATING, COOLING & VENTILATION TERMINAL EQUIPMENT
F.70 LPHW RADIATORS & CONVECTORS
F.71 NOT ISSUED
F.72 NOT ISSUED
F.73 GRILLES, DIFFUSERS & LOUVRES

F8 CALORIFIERS, CYLINDERS & HEAT EXCHANGERS
F.80 NOT ISSUED
F.81 NOT ISSUED
F.82 DOMESTIC ELECTRIC HWS HEATERS

F9 PUMPING, PRESSURISATION & WATER BOOSTING EQUIPMENT
F.90 CIRCULATING PUMPS
F.91 PRESSURISATION UNITS
F.93 WATER BOOSTER SETS – RESIDENTIAL APPLICATION
F.95 EXPANSION VESSELS

F.10 PRIMARY WATER & GAS PIPEWORK DISTRIBUTION

The installation of the mains water up to the meter and the installation of the meter shall be carried out by the Water Supply Company. The installation of the water supply pipe from the meter and all the distribution pipework to and within the building shall be carried out by the Contractor.

The installation of the incoming gas supply up to the meter position shall be carried out by the Gas Service Network/Infrastructure Company. The installation of the gas meter shall be carried out by the nominated Gas Supplier. The installation of the gas supply pipe from the meter and all the distribution pipework to and within the building or tenancy area shall be carried out by the Contractor.

No gas or water service pipework either before or after the meter shall pass through the demise of any building or tenancy area other than the building or tenancy directly served by the supply.

In the case of flats/maisonettes incoming gas and water supplies and services pipes between meters and the residential units may be routed through purpose constructed vertical or horizontal common pipe ducts but these shall be wholly located within the demise of the Landlords Areas of the building. Ducts shall be fire resisting and shall be fire stopped between each floor and at each entry point to a residential unit. Required access to common pipe ducts shall only be achieved from Landlords Areas. Ducts containing gas pipes shall be ventilated.

Gas installations shall be in accordance with Gas Safe regulations.

F.11 PIPEWORK

F.11.1 General

Pipework and fittings shall be suitable for the application, system pressures and operating temperatures. Where used in connection with potable services pipework and fittings shall be in accordance with WRAS requirements.

Sufficient points of access for dismantlement shall be provided for future maintenance and replacement.

Domestic water services pipework shall be installed in such a manner as to allow future inspection and replacement.

Pipework shall be installed in such a manner as to take into account the effect thermal expansion. Pipework shall not be subject to undue stress caused by thermal movement. This applies particularly to plastic pipework and the manufacturer's recommendations regarding the incorporation of expansion loops, bellows, guides and anchors shall be adopted.

Where specified, electrically heated trace heating tape shall be applied to the pipework. Where trace heating tape is to be applied to plastic pipework, the requirements of the pipework supplier/manufacturer shall be adopted which may include the installation of a metallic foil layer between tape and pipe surface.

F.11.4 Polyethylene/Polythene/PE Pipework for Buried Gas Services

Where specified buried gas services shall be run in yellow MDPE polyethylene pipework to BS EN 12007and British Gas Specification BGC/PS/PL2. Pipework fittings shall be to BGC/PS/PL2. Valves shall be to BGC/PS/VT Part 2.

Jointing shall be by polypropylene compression fittings up to size 90mm dia. Inaccessible joints and all jointing of sizes 110mm and over shall be by electrofusion welding undertaken by suitable specialist. Solvent welding of pipework shall not be permitted.

Pipework shall be installed in accordance with British Gas recommendations as specified in British Gas Publication IM/16 Section 4. Pipework shall be supported throughout its length.

MDPE pipework shall not be employed other than where buried. The change of pipework material from MDPE to steel or copper pipe shall be effected prior to the pipe emerging from underground location.

Protection to installed pipework and the identification of pipework routes by marker plates shall be carried out in accordance with British Gas Publication IM/16 Section 4.

The Contractor shall detail all necessary builderswork required including trenching, bedding and back filling which shall be carried out by the Main Contractor. The pipe shall be installed at least 650mm below ground level. The installation shall be in accordance with Gas Safe Regulations.

F.11.5 Polyethylene/Polythene/PE Pipework for Buried Mains Water Services

Where specified, the Contractor shall supply and install blue polyethylene MDPE pipework for below ground potable cold water services.

The pipework shall conform to BS EN12201. Brass/bronze pipework fittings shall conform to BS EN 1254, BS EN 12165 and BS EN 12164 (CZ 132).

Jointing shall be by polypropylene compression fittings up to size 90mm dia. Inaccessible joints and all jointing of sizes 110mm and over shall be by electrofusion welding undertaken by suitable specialist. Solvent welding of pipework shall not be permitted.

The Contractor shall not use polyethylene or any other plastic pipework material for under-ground installations within contaminated ground unless expressly authorized and approved by the Water Supply Company in writing.

The pipework shall be supported throughout its length.

MDPE pipework shall not be installed other than where buried. The change of pipework material from MDPE to steel or copper pipe shall be effected prior to the pipe emerging from underground location.

The complete installation shall be in accordance with the Water Supply Authorities regulations.

The Contractor shall detail all necessary builderswork required including trenching, bedding and back filling which shall be carried out by the Main Contractor. The pipe shall be installed at least 750mm below ground level. The installation shall be in accordance with the Water Byelaws.

F.11.6 Buried Water Services Pipework within Contaminated Ground

Where domestic water services pipework, including mains water, fire mains and domestic hot and cold water services is to be buried within ground known or suspected to be contaminated, the Contractor shall ensure the installation complies with the requirements of the Water Supply Company and WRAS.

Where the contaminant is methane, suitable pipework materials, subject to WRAS approval, shall be galvanised Iron to BS EN 10255, copper tube to BS EN 1057 R250 and PE/AL/PE barrier pipe as Protecta-Line PE (GPS) or Puriton (Uponor). Plastic pipework including fittings shall incorporate a metallic barrier and be approval of the Water Supply Company.

Galvanised iron pipework is to be further protected by wrapping in Denso Tape. Copper tube is to be further protected by either bonded PVC outer sheath as IMI Kuterlux PVC or by wrapping in Denso Tape.

F.11.7 Copper Pipework for LPHW Heating Services and Domestic Water Services

Domestic open system services (HWS, CWS, CWM) shall be installed in copper tube to BS EN 1057 R250 and jointed by either capillary or compression fittings to BS EN 1254 or by approved push-fit copper fittings as Geberit Mapress,

Where specified Low Pressure Hot water (LPHW) heating shall be installed in copper tube to BS EN 1057 R250 and jointed by either capillary or compression fittings to BS EN 1254 or by approved push-fit copper fittings as Geberit Mapress,

The use of Geeberit Mapress fittings is permitted subject to operatives having first received specialist training in the installation of these fittings, the strict adherence to the manufacturer's installation procedure, and the use of the recommended installation tools.

The pipework shall be adequately supported throughout with non-ferrous supports, brackets or clips. The routing and supporting of pipes shall take into account, thermal movement and correct grading to permit both air venting and drainage.

Pipework shall be installed vertically or horizontally subject to grading to permit proper draining and venting.

Adequate drain down points shall be provided to permit the complete drainage of the system.

In the case of domestic hot and cold water systems all valves and fittings shall be suitable for an 'open system' and shall be of copper or gunmetal construction and have the approval of the Water Supply Company.

The installation shall be in accordance with the Water Supply Regulations (1999) issued by the Department of the Environment. The Services shall be installed to achieve adequate water discharge at all draw-off points.

F.11.9 Polybutylene Pipework for Heating & Domestic Water Services

Where specified for Domestic Hot, Cold and Potable Drinking Water Services, the Contractor shall supply and install polybutylene tubing as manufactured by Hepworth Plumbing type HEP2O - Standard Pipe to BS 7291 complete with Hepworth Bitite fittings.

Where specified for Low Pressure Heating Services, the Contractor shall supply and install polybutylene tubing as manufactured by Hepworth Plumbing type HEP2O - Barrier Pipe to BS 7291complete with Hepworth Bitite fittings.

Polybutylene pipework shall not be used for domestic hot and cold water services where installed within screeds or other inaccessible areas or where buried.

Where used for heating services, polybutylene pipework may be used within screeds providing the pipework is insulated and sleeved.

Polybutylene pipework used for heating services may be used within floor, ceiling and roof voids providing the pipework is insulated and accessible.

No pipework joints shall be provided within the floor thickness.

Pipe fittings shall be Hepworth Bitite 'O' Ring push fit type and all joints and installation of fittings shall be carried out to Hepworth recommendation.

Where installed within or below screeds, heating services pipework shall be installed within Hepworth conduit system to allow future withdrawal and replacement of pipework. Pipework conduit systems shall be accessed at each end of each buried pipe section/run by the manufacturer's junction box which shall be located within cupboards/stores or under accessible kitchen/bathroom ducts/cupboards and as agreed with the Architect.

The installation of pipework systems shall be strictly in accordance with the manufacturer's recommendations.

Polybutylene pipework systems shall not be used on systems with maximum system pressure exceeding 4 bar.

Polybutylene pipework shall not be employed where water systems contain chlorine.

Where sections of polybutylene pipework provide non-continuity of bonding of copper and steel pipework, the Contractor shall ensure that each isolated section of copper and steel tube is bonded together.

F.11.10 Refrigerant Pipework

The complete installation and pressure testing of refrigerant pipework shall be carried out by a suitable specialist.

Best quality refrigerant grade copper tube to the appropriate BS/DIN/ASA standard shall be used for all refrigerant services. All pipework fittings shall be compression or solder type as appropriate.

The pipework installation shall be installed in a neat and workmanlike manner and shall be fully supported on continuous tray or clipped at close centres. Pipework shall be installed vertically or horizontally. Copper pipework shall be separated from contact with dissimilar metals by suitable insulation.

The installation shall be kept scrupulously free of any internal contaminants and debris and the greatest care shall be taken to keep any pipework open ends complete l sealed until final connections are made.

All pipework shall be insulated continuously with class O Armaflex with taped joints. Where installed externally all materials shall be suitable for external application.

Pipes must be spaced in a manner, which will permit subsequent access to any pipe for maintenance or removal without disturbance to the remaining pipes. Pipes must not be solidly built into walls or plaster and no joints are to be positioned within the thickness of the walls, floors or in any other inaccessible position.

Pipes shall be fixed with a minimum clearance of 32mm between surface of pipe or insulation. Pipes must not be married together by insulation material. Careful observance of parallels to line of walls both vertically and horizontally is required throughout.

F.11.11 Overflow Pipework

Overflow and warning pipework within plant rooms shall be run in copper tube to BS EN 1057 R250 as Clause F.11.7 up to and including 54mm diameter and in galvanised steel tubes to BS EN 10255 as Clause F.11.2 for sizes over 54mm diameter.

Overflow flows from WWPS and WC cisterns shall be run in white MUPVC pipework to BS EN 1329, 1451, 1455, 1519, 1565, and 1566.

Pipework shall be run with a continuous fall to drain of not less than 1:60.

Where over flow warning pipes are to be provided, the over flow pipe shall be run to discharge directly over a suitable gully position, and the warning pipe shall be discharged in a visible position in accordance with the Water Bylaws.

F.11.12 Condensate Pipework (Collection from cooling coils)

Condensate collection pipework shall be run in copper tube to BS EN 1057 R250 as Clause F.11.7 or UPVC wastepipe up to and including 54mm diameter.

Pipework shall be run with a continuous fall to drain of not less than 1:60.

The requirements of ACOP L8 shall be adopted regarding precautions against Legionnaires Disease. This shall include the provision of clear trap with water seal on the condensate discharge pipe of each appliance, and connection into the building waste system by means of an air break by tundish or gully.

All components of the condensate collection system shall be arranged for easy removal and cleaning.

F.11.13 ABS, PVC, uPVC and C-PVC Plastic Pipework for Special Applications

Where specified for particular applications, the Contractor shall install ABS, uPVC, or C-PVC pipework systems. In such circumstances the Contractor shall follow the instructions of the pipework manufacture with regard to methods of jointing, support, provision for expansion, thermal insulation and the installation of electric trace heating.

Unless specified otherwise ABS, PVC, uPVC and C-PVC pipework fitting and valves shall be as manufactured by Durapipe.

The pipework system shall be suitable for the specified test pressures and in any case shall be suitable for a minimum test pressure of 10 bar and the maximum and minimum operating temperatures.

Where employed on potable water systems, the pipework shall be fully compliant with WRAS requirements for the application.

Where sections of plastic pipework provide non-continuity of bonding of copper and steel pipework, the Contractor shall ensure that each isolated section of copper and steel tube is bonded together.

F.11.14 Pipe Clips and Brackets

General
Pipe brackets shall be either individual brackets each with separately fixed back plate or shall be multiple bracket arrangement with unistrut channel or similar galvanised steel/stainless steel fixing system.

Brackets shall be split ring type either single ring or double ring to suit application. Studding used to extend the pipe drop length shall be same material as bracket. Studding shall be stainless steel. All threads shall be metric.

Plastic clips, copper saddles and U-bolt brackets shall not be used unless specifically instructed.

Brass screws shall be used for fixing brass backplates and stainless steel screws shall be used for iron and stainless steel backplates/unistrut. Fixings to brick/block shall be made using appropriate proprietary plugs. Fixings shall not be made to plasterboard. Any addition timber grounds/battens to be provided for fixings shall be hardwood or treated softwood. Nailed fixings will be not accepted.

Pipe brackets shall be arranged to space pipework sufficiently of structure and other obstructions to permit installation of the full thickness of thermally insulation. In the case of cold water mains and chilled water pipework where insulation and vapour seal is to be continuous through pipe brackets, rigid phenolic foam insulation section shall be provided at all brackets.

Flanges, sockets and unions shall not be installed to coincide with support positions. Supports shall be provided adjacent to all valves and other components installed in pipe lines to prevent undue strain on the adjoining pipework and so that the component may be removed for maintenance leaving the adjoining pipework adequately supported.

Bracket shall be the correct size for the pipe and shall allow for thermal movement. All necessary anchors and guides shall be provided to counteract "slide" or "vertical" movement of piping due to expansion. Brackets shall be arranged to ensure correct grading of pipework for air elimination and drainage.

Steel and Galvanised Steel Pipework
Pipe brackets shall be malleable iron or stainless steel euro-clip type with rubber inserts.

Copper Pipework (excluding Refrigerant pipework)
Pipe brackets shall be cast brass (polished chrome where used with chrome finish pipework) or stainless steel euro-clip type with rubber inserts.

Plastic Pipework
Sufficient brackets shall be provided to ensure pipework does not belly or incorporate reverse-falls.
Soil and Waste pipework shall be clipped using proprietary plastic brackets supplied by pipework manufacturer for application.

Other plastic pipework (overflow, condensate etc) shall be clipped using brass or stainless steel brackets. Copper saddles may be used for pipe sizes up to 20mm.

Refrigerant Pipework
Generally continuously supported on and clipped/nylon tied to galvanised cable tray.

F.11.15 Spacing of Pipe Supports

All pipework shall be adequately supported and in no case shall the distance between supports exceed those given in the following tables. Supports shall allow free movement for expansion and contraction of pipework systems.

Pipe fixings and supports must be arranged at intervals not greater than the following, and intermediate supports shall be provided as necessary.

a) Copper Tube

Nominal Pipe Size	Horizontal Spacing Of Supports		Vertical Spacing Of Supports
Bare	Lagged	Lagged	Bare or Lagged
mm	m	m	m
15	1.2	1.2	1.8
22	1.2	1.2	1.8
28	1.8	1.5	2.4
35	2.4	1.8	3.0
42	2.4	1.8	3.0
54	2.7	1.8	3.0
65	3.0	2.4	3.7
76	3.0	2.4	3.7
108	3.0	2.4	3.7
133	3.7	3.0	3.7
159	4.5	3.7	3.7

b) Steel Tube

Nominal Pipe Size	Horizontal Spacing of Supports	Vertical Spacing of Supports
mm	m	m
15	1.8	2.4
20	2.4	3.0
25	2.4	3.0
32	2.7	3.0
40	3.0	3.6
50	3.0	3.6
65	3.0	4.5
80	3.6	4.5
100 and above	4.0	4.5

F.11.16 Pipe Sleeves

Sleeves shall be fitted where pipes pass through walls, floors, roof slabs and ceilings. For steel and galvanised steel pipework, sleeves shall be MDPE or mild steel pipe. For copper and plastic pipework sleeves shall be MDPE pipe. The weight of pipes must not be borne by the sleeves.

Sleeves shall be sized to permit freedom of movement of the pipes but the clearance all round must not exceed 8mm. In the case of walls, the sleeve shall be flush with the finished wall on both sides. In the case of floors, the sleeve shall be flush with the finished ceiling below and the finished floor surface.

Generally thermal insulation shall be terminated either side of the sleeve except in the case of chilled water, refrigerant and cold water mains pipework, where the thermal insulation and vapour seal shall be continuous through the sleeve. Where required for acoustic and/or fire separation, once pipework is installed, the sleeves shall be packed with suitable mineral packing to eliminate any air gaps

F.11.17 Air Bottles

Air bottles shall be fitted at all systems high points as necessary.

Air bottles, except where otherwise indicated on the drawings, shall be 50mm diameter and a minimum of 300mm long. A 12mm discharge pipe shall be run from each air bottle to approximately 1m. above floor and fitted with an air cock.

F.11.18 Air Vents and Drain Down Points

At all system high points a manual air venting cock shall be provided suitably positioned to permit easy access. Drain down cocks shall be provided at all system low points. Drain cocks within the boiler room shall be 25mm diameter.

F.11.19 Flexible Pipework Connections

All flexible pipework connections shall be provided to pumps and other items of plant and equipment subject to vibration and movement in accordance with Section I.

The Contractor shall ensure that pipe connections are correctly aligned so that no strain or offset of the flexible connection is caused.

F.11.20 Expansion

Pipework shall be arranged to allow freedom of movement for expansion. Fixed anchor points as necessary shall be provided to direct expansion toward the expansion loops/bellows as required. All pipework shall be arranged to prevent expansion stress on all connections to equipment. Drawings showing the position of all anchor points together with anchor details shall be submitted to the Engineer prior to installation.

F.12 PIPEWORK SYSTEM TREATMENT

F.12.1 LPHW and Closed Systems

After completion of pressure testing, the Contractor shall drain down the various systems. All isolating valves at coil control valve locations shall be closed and each system shall then be refilled with clean water and a suitable detergent/degreasing agent shall be introduced. The system contents shall be circulated by means of the system pumps for a suitable period as recommended by the water treatment specialist after which period the system contents shall be drained down.

Each system shall then be thoroughly flushed through with mains water introduced into the high points of each system with the drain down valves at the lowest point in each system left open and piped to drain. Flushing through shall continue until the discharging water runs clear.

The Contractor shall ensure that in the process of cleaning/flushing through, all legs and branches of each system are properly circulated. At no time during this process shall any heat exchanger coils, be open to the system.

On final fill, the Contractor shall include for chemically dosing the installations for permanent protection against corrosion and electrolytic action. The LPHW system shall be provided with a dosing pot as indicated on the design drawings, the contractor shall provide 2 no. 25 litre drums of Heatreat 551 and Heatreat 719 as supplied Houseman Burnham Ltd.

F.12.2 Domestic Hot & Cold Systems

The Contractor shall thoroughly flush out the system to remove all debris and shall then sterilize the pipework systems including tanks and cylinders, by introduction of chlorinated water.

Chlorination shall be carried out strictly in accordance with the Water Authority's regulations and Public Health/Environmental Health Officer's requirements.

F.13 PIPEWORK EXPANSION DEVICES

Pipework shall be arranged to allow freedom of movement for expansion. Fixed anchor points as necessary shall be provided to direct expansion toward the expansion loops/bellows as required.

All pipe work shall be arranged to prevent expansion stress on all anchor points together with anchor details shall be submitted to the Engineer prior to installation.

All flexible pipe work connections to pumps and other items of plant and equipment subject to vibration and movement shall be provided as manufactured by Teddington Engineering or equal or as specified elsewhere.

The Services Contractor shall ensure that pipe connections are correctly aligned so that no strain or offset of the flexible connection is caused.

No proprietary expansion bellows or compensators shall be provided unless specifically indicated on the drawings.

Pipework shall be installed in accordance with Clause F.11 of this Specification.

F.14 VALVES & STRAINERS

F.14.1 General

Sufficient number of isolating, regulating and balancing valves shall be installed in the pipe work systems to allow the complete and satisfactory balancing of all systems to achieve the required water flow rates consistent with the design requirements.

Isolating valves shall be provided on all connections to items of plant such as pumps, boilers, tank/cisterns and storage cylinders to allow the easy removal of plant for maintenance/replacement.

All pipework connections to equipment such as radiators, fan convectors, heater coils, shall be provided with isolating valves.

Drain down points shall be provided at all low points in the pipework system and elsewhere as necessary to permit the complete drainage of the system.

Air release vents shall be provided at all high points in the pipework system.

Strainers shall be provided on all closed circuit pumped LPHW heating and chilled water systems.

Isolating valves shall be provided on all Domestic Water Services branch connections serving each separate room or facility and in additional service valves shall be provided on all final connections to individual items of sanitary ware or kitchen/laundry equipment. In the case of dishwashers and washing machines all final hot and cold water connections shall also be fitted with double check valves.

F.14.2 Valve Types

Valves shall be manufactured by Hattersley Ltd unless otherwise stated.

a) Open Systems

Stopcock	BS 1213
Float Valves	BS 1212
Equilibrium Float Valve	BS 1212
Drain Down Valve – Plant Room	Hattersley Fig 81HU
Drain down Valve - Generally	Hattersley Fig 371 or Pegler Patten 833
Isolating Valve (up to 50mm)	Hattersley Fig 30C
Isolating Valve (65mm and above)	Hattersley Fig 950W/970W
Regulating Valve	Hattersley Fig 1432/953W
Non-Return Valve	Hattersley Fig No 47/761
Double Check Valve (Domestic)	Pegler 8028
Double Check Valve	Hattersley Fig 249 PN16
Pressure Reducing Valve	Hattersley Fig 416 PN16 and Fig 425 PN25
Thermostatic Anti-Scold Mixing Valve	Reliance TMV2 (TMV3 for Healthcare/Hospitals etc)
Reduced Pressure Zone Valve	NABIC Fig 255
3 Way Vent Cock	NABIC Fig 175
Service Valve	Hattersley Fig 108 PN16 + Plastic Handle

b) Heating and Chilled Water Systems

Isolating Gate Valve up to 50mm	Hattersley Fig 30/33X PN20
Isolating Gate Valve 65mm and over	Hattersley Fig 541 PN16
Isolating Butterfly	Hattersley Fig 950/970
Regulating Valve up to 50mm	Hattersley Fig 5
Regulating Valve 65mm and over	Hattersley Fig 731
Double Regulating Valve up to 50mm	Hattersley Fig 1432
Double Regulating Valve 65mm and over	Hattersley Fig MH 733
Commissioning Set up to 50mm	Hattersley Fig 1000
Commissioning Set 65mm and over	Hattersley Fig M2000 PN16
Non Return Valve up to 50mm	Hattersley Fig 47
Non Return Valve 65mm and over	Hattersley Fig 651 PN16
Drain Down Valve – Plant Room	Hattersley Fig 81HU
Drain down Valve - Generally	Hattersley Fig 371 or Pegler Patten 833
3 Way Vent Cock	NABIC Fig 175
Service Valve – (Fan Coil Units etc)	Hattersley Fig 108 PN16
Radiator Valve	Hattersley Fig 3150/3250 and 3300LS/3400LS

c) Gas Service

All valves shall be to Gas Supply Authorities Specifications.

Main Stop Valve 65–300mm	Fig 971YL
Isolation/Stop Valve 15-50mm	HNH Fig 100YL Butterfly Valve
Isolation/Stop Valve 65mm and over	HNH Fig 201M Lubricated Plug Valve

d) Safety/Pressure Relief Valves

Valves shall be supplied with correct pressure relief rating and each valve shall be provided with durable label to identify rating. Valves shall be as follows:

Safety Valve - all sizes	NABIC 542
Pressure Relief Valve – all sizes	NABIC 542L

e) Thermostatic Radiator Valves

Where it is necessary to connect radiators to constant temperature LPHW circuits and wherever else specified as a requirement, Danfoss Revolver or equal direct acting thermostatic radiator valves shall be installed.

Remote sensors and adjusters shall be installed where the valve body is concealed behind panels.

F.14.3 Strainers

Strainers shall be as manufactured by Messrs Spirax, screwed bronze type up to 50mm and flanged cast iron over 50mm. Strainers shall be provided on each pumped circuit located on the discharge of the pump.

F.14.4 Air Bottles

Air bottles shall be fitted at all systems high points as necessary. Air bottles, except where otherwise indicated on the drawings, shall be 50mm diameter and a minimum of 300mm high. A 12mm discharge pipe shall be run from each air bottle to approximately 1000m above floor and fitted with an air cock.

F.14.5 Air Vents and Drain Down Points

At all system high points a manual air venting cock shall be provided suitably positioned to permit easy access. Drain down cocks shall be provided at all system low points. Drain cocks within the boiler room shall be 25mm diameter.

F15 WATER CONDITIONING, FILTRATION, STERILISATION AND SOFTENING EQUIPMENT

F.15.4 Water Conditioning Unit

Water conditioning units shall be as manufactured by Hydrotec Ltd and shall be type Hydromag physical water conditioning unit. The installation shall be in accordance with Hydrotec's recommendations.

The unit shall be positioned within the property on the main incoming water supply pipe to the property before any supply branch take-offs on a section of straight copper pipe with at least 0.5m straight pipe without out fittings on each side of the unit.

The unit shall be provided with valved bypass sized at same size as main water service.

The unit size shall be same as the specified water service pipeline size.

The system shall be complete with Hydrotec Standard Plus Control Box.

F.15.5 Magnetic Filter for Central Heating Systems

Magnetic filters shall be provided on all residential and commercial heating installation as indicated on the drawings as manufactured by Adey Ltd type MagnaClean. One filter shall be installed on each separate heating system.

Filters shall be installed in accordance with the manufacturer's instructions and shall be located on the common flow pipe near to the boiler location. The filter shall be complete with bypass manifold and isolating valves to permit serving without out bypass with need to isolate the heating system.

For residential projects with boiler ratings up to 30kW the MagnaClean Professional 2 (22mm) shall be installed.

For large residential projects and small commercial with boiler ratings up to 60kW the MagnaClean Professional 2XP (28mm) shall be installed.

F.16 TANKS & CISTERNS

All tanks and cisterns shall be purpose constructed from either glass reinforced plastic sheet or mild steel plate to BS 1564: Type 1, shall be provided with close fitting lid, be complete with all necessary connections and tappings and steelwork supports and, unless expressly specified to the contrary, shall meet the requirements of "Water Bylaw 30".

Tanks shall be constructed as follows:

Up to and including 1000 litres nominal capacity shall be of unitary construction, moulded in one piece from polyester resin/glass fibre, and shall have an integral welded steel frame encapsulated within the laminate to reduce deflection, as manufactured by Messrs Dewey Waters, or approved equal.

Up to and including 1000 litres nominal capacity shall be of unitary construction of welded mild steel and hot dipped galvanised after manufacture to BS 417.

4500 litres nominal capacity and over shall be constructed from pressed 8mm/steel sections as manufactured by Messrs Braithwaite, or approved equal. Flanges shall be external and the tank shall be erected at site by the manufacturer. The tank shall be supported on cross beams designed by the structural engineer and installed under the main contract.

4500 litres nominal capacity and over shall be constructed from polyester resin/glass fibre sections as manufactured by Messrs Dewey Waters or approved equal. Flanges shall be external and the tank shall be erected at site by the manufacturer. The tank shall be supported on cross beams designed by the structural engineer and installed under the main contract.

Tanks of nominal capacity 1000 litres to 4500 litres shall be constructed as either i), iii) or iv) above to suit application and available space. Where pre-insulated tanks are specified these shall be constructed generally as iv) above except tank sections shall incorporate 50mm encapsulated plastic closed cell foam thermal insulation of approved type.

All tanks shall be adequately supported and it shall be the Contractor's responsibility to ensure that all tank supports are approved by the Architect/Structural Engineer prior to installation. Tanks shall be fully supported for the complete length of all tank flanges. Tanks shall be insulated from supports by a damp proof membrane type 'Ledcore' or similar approved material.

Tanks shall be located to provide at least 600mm access space above tank. Tanks in excess of 4500 litre capacity shall have at least 750mm access space over tank.

Adequate facility shall be provided to gain access to the ball valve and internal surfaces of the tank for maintenance, tank cleaning and painting.

Where it is impractical for access to be achieved by removal of the complete tank lid or where the tank has a capacity of 1000 litre or more, hinged manhole access traps shall be provided in the lid. Where necessary, and in all cases where the tank depth is greater than 1.5m

internal/external access ladders shall be provided. Where tanks are 2.0m or over in height and where there is sufficient height above the tank to allow personnel to walk or crawl over the tank top, safety handrails shall be fitted around the tank top.

All tanks shall be internally braced as necessary to prevent undue deflection of tank or structural instability when the tank is filled to the brim.

The internal surfaces of all tanks shall be protected with two coats of Bitumastic paint to the Water Bylaws and Water Supply Company's Regulations.

Whether expressly stated or not, all cold water storage tanks over 10,000 litres shall be provided with a dividing plate to effect two operational tank chambers; each approximately 50% capacity. The two tank compartments shall be linked by external balance pipe valved at each tank connection and all Services Connections shall be taken from the balance pipe. A separate ball valve, overflow and access shall be provided to each tank compartment.

To reduce risk of stagnation, in each tank or tank compartment, the water inlet position and the service outlet positions, shall be located such that there is the maximum cross-flow of water within the tank.

Each tank or tank chamber shall be provided with an overflow pipe of at least two pipe sizes larger than the ball valve connection size. Tanks or tank chambers of capacity 4500l and over shall be provided with a 25mm overflow warning pipe.

Overflow pipes shall be extended to discharge over suitable gully positions. Warning pipes and overflow pipes where no warning pipe is provided shall discharge in a visible position in accordance with the Water Authority's requirements.

Each tank or tank chamber shall be provided with a drain down/clean out cock of at least 25mm on tanks up to 1000 litres, 40mm on tanks up to 4500 litres and 50mm on tanks over 4500 litres actual capacity.

All tank pipe work connections except overflows, warning pipes and open vents shall be provided with isolating valves as close to the tank/balance pipe connections as practical. The size of all open vents, overflows, ball valves, water feeds, and service connections shall be consistent with the requirements of the system and in accordance with CIBSE requirements and Water Supply Company's Regulations.

Where there is sufficient height above the tank to allow personnel to walk or crawl over the tank top, the tank lid shall be design to take a personnel weight of at least 150kG. Permanent and prominent warning signs shall be provided to warn of any weight restrictions. Where the tank top is 2.0m or more above floor/ground level and where access to the tank top is available, the tank top shall be fitted with safety handrail.

F.20 DUCTWORK

F.20.1 General

The design manufacture, erection and testing of all sheet metal ventilation ductwork shall be carried out strictly in accordance with the HVCA DW/144 Specification for general applications and HVCA DW/172 for kitchen applications as prepared by the Heating and Ventilating Contractors Association, unless indicated to the contrary in this Specification.

The design manufacture, erection and testing of all plastic and glass fibre ventilation ductwork, where this has been specifically specified, shall be carried out strictly in accordance with the HVCA DW/154 Specification as prepared by the Heating and Ventilating Contractors Association, unless indicated to the contrary in this Specification.

The installation of fire dampers shall be carried out strictly in accordance with the HVCA DW/145 Specification as prepared by the Heating and Ventilating Contractors Association, unless indicated to the contrary in this Specification.

Where the HVCA DW/144, 145, 154, 172, Specifications indicate preferred or recommended arrangements, these shall be taken as mandatory for this Contract.

Ductwork shall be detailed, fabricated and erected by a Specialist under this Sub-Contract and all workmanship shall be of the highest standards.

Detailed ductwork fabrication and installation drawings shall be provided by the Contractor and shall be approved by the Architect and Engineer prior to fabrication and erection. Ductwork drawings shall be fully detailed and based on actual site dimensions and be coordinated with the structure and other services. Drawings shall dimensionally set out services on plan and elevation and detail fixings and supports. Setting out of ductwork shall take into account space required around service for thermal insulation and access to dampers and fire dampers.

Hangers and supports shall be provided in accordance with DW/144. Hangers and supports shall be provided to completely and independently support all items of plant and equipment and in addition hangers and supports shall be provided to support the ductwork installations at intervals not exceeding the requirements of BW 144 Table 15.

Access doors shall be provided in accordance with DW/144 and shall be provided adjacent to each fire damper and balancing damper and in addition access doors shall be provided at minimum centres of 10m intervals for cleaning purposes.

Additionally, access doors shall be provided on the kitchen extract system at each change in direction and at each transition piece.

Where access doors are required in insulated ductwork services, these shall be of the double skin pre-insulated type as manufactured by Messrs Actionair.

Fire dampers shall be provided where ductwork passes through fire walls, ceiling void smoke barriers and floor slabs, to give a minimum of 2 hour fire rating and these shall be as manufactured by Messrs Actionair.

All ductwork shall be provided with 25mm diameter air volume test holes with tight fitting plastic plugs and these shall be located as required for commissioning purposes. Test holes shall be indicated on the Specialist's drawings prior to manufacture.

F.20.3 Flexible Ductwork

Where specified, circular flexible ductwork up to a maximum of 300mm diameter may be used to make final connections to grilles and diffusers. The duct type shall be flame resisting PVC with helical steel wire carcass as manufactured by Flextract type ANS.

Flexible ductwork shall be installed strictly in accordance with the manufacturer's recommendations.

Flexible ductwork shall be fully supported and installed to ensure all changes in direction are by easy bends with no deformation of the duct profile. The length of the flexible duct shall not exceed 1.0m.

Flexible ductwork shall be thermally insulated where conveying warmed or cooled air.

Flexible ductwork shall not be installed through floor or wall structures. Flexible ductwork shall not be used in external locations or within or where buried or in any location or where not fully accessible.

F.20.4 Duct Connections to Fan Coil Units

Where chassis type fan coil units, including direct expansion heating/cooling room units, are to be located in builders work casings or enclosed or concealed within joinery, the Contractor shall allow for the fabrication of duct connections from the return air grille to the fan coil unit, and from the fan coil unit to the supply/discharge grille. Final connections to the fan coil unit shall be by flexible connection to avoid vibration transmission.

Duct connections shall be sheet metal fabrication to DW/144 and shall generally be sized at grille cross sectional size with gradual change of section to match fan coil spigot sizes. Duct turns shall be fitted with vanes. Ductwork shall be thermally insulated.

F.21.8 Extract Ventilation Fan Sets

Axial fans shall be of the direct drive arrangement with standard length galvanised steel casings supplied with manufacturers mounting feet all as manufactured by Flakt Woods, Nuaire or VES Ltd. or equal approved.

Centrifugal extract fan sets comprising belt driven forward curved fan, motor assembly, sub frame and galvanised sheet steel casing shall be provided as detailed on the drawings.

Fan impellers shall be statically and dynamically balanced and bearings shall be of the 'sealed for life' pattern requiring no regular lubrication.

Motors shall be of the totally enclosed fan cooled type rated for continuous operation at 40°C ambient conditions with at least 25% margin over the design absorbed fan power. Motors shall be suitable for either 400V 3 phase 50 Hz or 230V Single Phase 50Hz electrical supply as specified elsewhere.

The fan motor shall be supported on steel sub frame assemblies, which shall be provided with 25mm deflection spring anti-vibration mounts to provide isolation from the main plant frame. Suitably approved flexible ductwork connections shall be provided on the discharge side of fans to prevent vibration transmission.

Fan selection shall provide maximum efficiency and stability of performance.

The extract fan units shall be supported or mounted by means of anti-vibration mountings to ensure no vibration is transmitted to the structure.

All fan drives, exposed shafts and pulley wheels shall be fully enclosed in a robust galvanised steel wire safety guard.

Flexible ductwork connections shall be provided on ducted inlet and outlet connections.

Ductwork silencers shall be provided to achieve the required internal/external noise levels.

F.24 DUCT-LINE MOUNTED SUPPLY AND EXTRACT FANS

Axial fans shall be of the direct drive arrangement with standard length galvanised steel casings supplied with manufacturers mounting feet all as manufactured by Messrs. Woods Ltd.

Centrifugal extract fan sets comprising belt driven forward curved fan, motor assembly, sub frame and galvanised sheet steel casing shall be provided as detailed on the drawings and as manufactured by Nuaire, Vent Axia or VES or equal and approved.

Fan impellers shall be statically and dynamically balanced and bearings shall be of the 'sealed for life' pattern requiring no regular lubrication.

Motors shall be of the totally enclosed fan cooled type rated for continuous operation at 40°C ambient conditions with at least 25% margin over the design absorbed fan power.

The fan motor shall be supported on steel sub frame assemblies, which shall be provided with 25mm deflection spring anti-vibration mounts to provide isolation from the main plant frame. Suitably approved flexible ductwork connections shall be provided on the discharge side of fans to prevent vibration transmission.

Fan selection shall provide maximum efficiency and stability of performance.

The fan units shall be supported or mounted by means of anti-vibration mountings to ensure no vibration is transmitted to the structure or to the connecting ductwork.

Flexible ductwork connections shall be provided on ducted inlet and outlet connections of minimum effective length 100mm. The fan shall be independently supported and no weight shall be imposed on the flexible connections. Flexible connections shall not be used to provide change in duct section and shall be aligned between fan connection and ductwork without deviation.

All fan drives, exposed shafts and pulley wheels shall be fully enclosed in a robust galvanised steel wire safety guard.

Ductwork silencers shall be provided to achieve the required internal/external noise levels.

F.28 TOILET, BATHROOM & KITCHEN EXTRACTOR UNITS

F.28.1 Toilet & Bathroom Extractor Units

The Contractor shall provide in the positions indicated on the drawings, self-contained ventilation extractor units as manufactured by Vent Axia Ltd, Greenwood Airvac Ltd, Silavent Ltd, Nuaire Ltd or equal.

The performance of extractor units shall be in accordance with the Building Regulation requirements.

Where installed within reach of persons using a bath or shower or as required or recommended within the IEE Regulations, extra low voltage (SELV) units shall be provided and these shall be complete with integral transformer.

Units shall be of the twin fan arrangement with automatic changeover of fan failure and also periodically to even fan wear. A run-on timer shall be provided to maintain ventilation for a variable period of 10-20 minutes after isolation.

Where specified, bathroom fans shall be fitted with humidistat control arranged to automatically operate the fan on high humidity.

Speed controllers shall be installed to meet ventilation rates as specified. Transformer speed controllers shall be used for non EC fans. These shall be located centrally in or adjacent to the mechanical services control panels.

Unless stated otherwise, units shall be wired into the local switched lighting circuit with an additional un-switched supply provided as necessary to effect run-on and humidistat controlled operation.

Extract units shall be of the following arrangements as indicated on the drawings:

a) Arranged for direct mounting onto external walls and shall be complete with fixing kit including discharge spigot, ducted terminal.

b) Arranged for a ducted discharge with the extraction mounted on the underside of the ceiling or at high level on internal walls and shall be complete with ‘low profile’ rectangular pvc discharge ducting and external grille.

Where the discharge ductwork is routed through unheated roof or service voids, the ductwork shall be insulated and a proprietary condensate trap shall be fitted with drain run to a suitable approved point of discharge.

Extractor units shall be quiet in operation and shall meet the specified room noise level when operating at normal speed.

F.28.2 Kitchen Extractor Units

Shall be as per kitchen designer specification. The contractor will check that

F.28.3 Operation and Control of Toilet and Bathroom Ventilation Systems

Domestic Applications

Toilet and bathroom extract systems shall be locally controlled by PIR or by local lighting circuit operation as specified elsewhere.

Fans shall be arranged to continue to operate for 15 minutes after toilet or bathroom has been vacated.

Speed controllers shall be installed to meet ventilation rates as specified. Transformer speed controllers shall be used for non EC fans. These shall be located centrally in or adjacent to the mechanical services control panels.

If control is specified as being by PIR, fans shall be wired either from local lighting or small power circuit with fused connection unit as specified. If operation is to be controlled by local lighting circuit then shall be wired off the local switched and un-switched lighting circuit.

F.30 THERMAL INSULATION

F.30.1 General

The Contractor shall provide thermal insulation as described within this Specification. The work shall be undertaken by a Specialist Contractor and the workmanship and materials shall be to the highest standard and the works shall be completed to the satisfaction of the Engineer.

All materials shall be in accordance with the Building Regulations, the requirements of the Building Control Officer, the Fire Prevention Officer and the Public Health/Environmental Health Officer. No asbestos based materials shall be used.

The application of thermal insulation, insulation materials and the performance of thermal insulation shall meet or exceed the requirements of BS 5422 and BS 5970. All insulation materials shall be in accordance with Building Regulations Part B regarding spread of flame and smoke and fume requirements.

All pipework, pipework fittings, ductwork, tanks, cisterns, heat exchangers, cylinders, boilers, air handling plant and any other parts of the system shall be thermally insulated:

- Where it is necessary to do so, to avoid the risk of water freezing within the system
- To prevent the formation of condensation on cold surfaces
- To prevent wasteful heat loss from all hot/warm surfaces
- To prevent wasteful heat gain to all cold surfaces
- To reduce the surface temperature for safety reasons

All LPHW and MPHW heating services pipework shall be insulated, other than the embedded heating coils and short final connections to radiators and heaters.

All domestic hot and cold water services shall be thermally insulated except final exposed to view short connections to sanitary ware unless insulation is required for health and safety reasons.

All refrigerant pipework shall be insulated.

All external pipework shall be thermally insulated.

Where the operating conditions of the system means that the surface temperature of pipework, pipework fittings, ductwork, plant, etc. is at or below the room dew point temperature and wherever there is a risk of the formation of condensation, a continuous and imperforate vapour barrier shall be provided to encapsulate the thermal insulation. This includes but is not limited to cold water mains pipework, refrigerant pipework, chilled water pipework and chilled air ductwork. The vapour barrier shall comply with the Building Regulations requirements for Spread of Flame and shall where practical take the form of reinforced aluminium foil.

All joints shall be lapped and securely pasted down. Where there is a risk of damage to the vapour barrier such as in plant rooms, and where the service is exposed to view a protective aluminium cladding shall be applied.

Rigid pipe sections and slabs shall be used in plant rooms, services shafts and ducts and where exposed to atmosphere and exposed to view. Flexible mattress may be used in ceiling voids but not where vapour barrier is required.

Where domestic HWS services are specified without return circulation pipework, electrical trace heating shall be provided as required to meet the requirements of ACOP L8. Where water pipework services are exposed to atmosphere and where services are at a risk of freezing, electric trace heating shall be provided.

All insulation exposed to atmosphere shall be protected by means of a suitable weatherproof membrane of two layers of polyisobutylene sheeting or similar. The whole shall be securely fixed in position and all joints pasted down with appropriate adhesive.

All metal bands, clips and fixings shall be either nonferrous or galvanised finish.

F.30.2 Insulation Materials

Insulation shall be of glass fibre or rockwool materials which are non-corrosive to ferrous and non-ferrous materials. They shall be non-combustible, water repellent, rot-proof, sterile, offer no sustenance to vermin and shall not be deleterious to health and safety.

All thermal insulating materials shall be classified as non-combustible in accordance with BS 476, Part 4, the surface spread of flame rating shall be Class 1 when tested in accordance with BS 476, Part 7, and the fire propagation rating shall meet Class "O" when tested in accordance with BS 476, Part 6.

Bonding agents shall have a flash point of not less than 163°C. Thickness of insulation materials shall be in accordance with BS 5422.

Glass fibre/mineral wool pipe sections shall be of a minimum 80kg/m^3 density and shall have a maximum thermal conductivity (k) of 0.040W/m.K.

Vapour Seals shall be Class "O" finish integral with sectional slab insulation shall comprise a white lacquered, foil reinforced, aluminium foil/kraft laminate.

All coverings and adhesives shall meet the requirements of BS 476, Part 4, the surface spread of flame rating shall be Class "1" when tested in accordance with BS 476 Part 7, and the fire propagation rating shall meet Class "O" when tested in accordance with BS 476, Part 6.

Metal Valve and Flange Boxes shall be constructed of aluminium comprising two halves, which shall be hinged and fitted with quick release toggle clips for easy removal.

Boxes will be lined with the same material and to the thickness of the adjacent pipeline. In all cases, boxes shall extend over the insulation on the pipeline, which it serves. The insulation shall be terminated short of the fitting so as to allow clearance for bolt withdrawal.

F.30.3 LPHW, MPHW and Domestic Water Pipework

Insulation shall be to the following minimum thicknesses:

Copper Tube	LTHW + Dom HWS	LTHW + Dom HWS	LTHW + Dom HWS
Nom. Pipe Size	k = 0.025 (Phenolic Foam)	k = 0.03	k = 0.04 (Rockwool)
15	14	19	33
22	15	21	35
28	17	22	37
35	18	23	38
42	19	25	40
54	20	26	41
76	22	28	43
108	23	29	43

Steel Tube	LTHW + Dom HWS	LTHW + Dom HWS	LTHW + Dom HWS
Nom. Pipe Size	k = 0.025 (Phenolic Foam)	k = 0.03	k = 0.04 (Rockwool)
15	16	22	39
20	18	25	42
25	20	27	44
32	22	29	46
40	23	30	48
50	25	32	51

65	27	35	53
80	28	36	54
100	30	38	56

Steel Tube	MTHW	MTHW	MTHW
Nom. Pipe Size	k = 0.025 (Phenolic Foam)	k = 0.03	k = 0.04 (Rockwool)
15	16	21	36
20	20	26	45
25	23	31	53
32	26	35	57
40	27	36	58
50	30	39	62
65	32	42	65
80	34	44	68
100	37	47	71
125	39	50	74
150	41	52	76

LPHW pipework shall be insulated with Class "O" faced preformed rigid glass/mineral wool pipe sections, longitudinal seams shall be sealed with a suitable adhesive and butt joints shall be sealed with 100mm wide matching tape. Bends, fittings, flanges and pipe clips to be neatly cut on site and finished to match adjacent pipework. Insulation to be further supported by three aluminium bands per section.

All termination points where insulation would be exposed to damage shall be fitted with end capping of the correct dimension so as not to cause a heat bridge.

F.30.5 Cold Water Pipework

Mains Cold Water pipework shall be insulated throughout except where buried below ground to a depth of at least 600mm.

Mains Cold water shall be provided with a continuous vapour barrier.

Insulation shall be to the following minimum thicknesses:

Copper Tube	Cold Water	Cold Water	Cold Water
Nom. Pipe Size	k = 0.025 (Phenolic Foam)	k = 0.03	k = 0.04 (Rockwool)
15	17	20	25
22	19	22	28
28	20	24	31
35	22	25	33
42	23	27	35
54	25	29	37
65	26	31	40
76	27	32	42
108	30	36	46

Steel Tube	Cold Water	Cold Water	Cold Water
Nom. Pipe Size	k = 0.025 (Phenolic Foam)	k = 0.03	k = 0.04 (Rockwool)
15	19	22	28
20	20	24	30
25	21	25	32
32	23	27	35
40	24	28	36
50	26	30	39
65	27	32	42
80	29	34	44
100	31	36	47
125	32	38	50
150	34	40	52

F.30.6 External Pipework - All Services

Pipework shall be insulated with plain fibre glass/mineral wool rigid pipe sections, all secured into position with tape. Bends and fittings to be neatly cut around and fixed into position. Insulation to be covered with 0.8 polyisobutylene sheet with all laps secured with an approved solvent adhesive. Points where the sheet may be punctured to be sealed with manufacturers recommended sealant.

Valves and flanges shall be insulated by using oversized sections and finally wrapping with polyisobutylene sheet so as to achieve weather protection. Where further protection is needed through exposure to mechanical damage pipework should be further clad with 22 SWG galvanised sheet metal secured by pop rivets.

F.30.7 Pipe Sleeves

Insulation shall be continued through the pipe sleeve including the vapour seal where required. The space between the sleeve and the insulation shall be carefully packed with mineral wool so as to form a fire stop of the designated rating.

F.30.8 Cold Water Storage Tanks in Plant Rooms and Unheated Areas

Rectangular tanks shall be insulated with Class "O" faced rigid duct insulation (48kg/m^3), the insulation to be cut so that the top and bottom slab overlap the sides. The insulation to be bonded to the tanks sides by means of a suitable adhesive applied in accordance with the

manufacturer's instructions. All slabs are to be closely butted together and joints sealed with 100mm wide matching self-adhesive tape. Any exposed edges or points where covering is penetrated to be sealed with sealant or tape.

In the case of sectional tanks, each module shall be blocked out so as to bring the outside face of the slab level with the flange, thus achieving a smooth face over the sides of the tanks; insulation shall then be carried out as before described.

F.30.9 Cylinders and Calorifiers (Circular)

Vessels to be insulated with 100mm thick mineral wool/lamella matt (40-50kg/m^3), the insulation to be wrapped around the vessel and bonded with a suitable adhesive, all joints to be closely butted together and sealed with matching self-adhesive tape.

Insulation to be finally covered with 20 SWG Hammerclad aluminium sheet, secured with pop rivets.

F.30.12 Air Conditioning Ductwork

All air conditioning ductwork that is all ductwork connecting from the discharge side of air handling equipment containing air cooler batteries shall be insulated as follows:

Ductwork in Plant Rooms

The whole of the ductwork within the plant rooms shall be insulated with 48kg/m^2 density glass fibre foil faced slab 50mm thickness or other approved, firmly totally adhered to the ductwork using an approved adhesive.

The aluminium foil finish shall provide a vapour barrier seal to all ductwork carrying conditioned air. The vapour barrier shall be maintained as a complete barrier without damage or omission.

Additional support to the underside insulation on wide girth ducts shall be achieved by the use of nylon hangers and washers, bonded to the substrate at 0.3m centres with a neoprene adhesive at a rate of 250 hangers per litre, as Fosters Clipfas 13 - 29 or approved.

All circumferential and longitudinal butt joints on the insulation shall be filled and sealed with a sealant as Fosters Foamseal 30 - 45 or approved.

All circumferential and longitudinal joints shall be taped with 100mm wide foil faced tape. All seams shall be dry and dust free before application of the tape.

All nylon support hanger washers shall be covered with felt pads and taped as above where vapour barriers are to be maintained.

The insulation shall be clad in either:

a) 0.711mm aluminium sheeting ("Stucco" finish) and be take over all ductwork supports. The sheeting shall be stiffened to avoid sagging with the stiffeners a maximum of 25mm depth on the inside face of sheeting, or
b) Isogenopak rigid PVC cladding system comprising roll and preformed pipe and duct sections and applied in accordance with the manufacturer's instructions by suitable specialist.

Cladding to the circular bends shall be formed by the swaging together of segments.

The whole of the circular ductwork within the plant room shall be insulated as described above for the rectangular ductwork with the exception that 50mm thickness foil faced lamella glass fibre blanket shall be used and not the slab type glass fibre. Sufficient fixings shall be provided to prevent sagging of the insulation.

Ductwork in False Ceiling, and Vertical Ducts

All supply ductwork, in false ceilings, voids, vertical ducts, etc., shall be insulated with 20kg/m^3 density aluminium foil faced glass fibre slab finished to Class "0" as defined in the Building Regulations or other approved, firmly totally adhered to the ductwork. On wide girth ducts additional support using nylon hangers and washers as specified under Clause F.30.12 shall be used. The longitudinal joint shall be formed by overlapping the insulation foil finish 50mm minimum and taping.

Horizontal butt joints shall not be permitted. Horizontal joints shall be lapped with the aluminium foil detached from the lapped section of insulation, carried across the joint and secured to the top foil using 100mm wide aluminium tape. Circumferential butt joints shall be filled and sealed with a sealant as Fosters Foamseal 30-45 or equal and approved.

All circumferential and longitudinal joints shall be taped with 100mm wide foil faced tape. All seams shall be dry and dust free before application of the tape.

The Contractor shall ensure that ambient conditions are as the manufacturer's specification before commencing application of the tape so as to ensure total adhesion.

The Contractor shall take care to ensure a continuous vapour seal is provided.

The corners and edges of the insulation shall be protected with aluminium angle and the whole encased with galvanised 25mm mesh wire netting 1mm thick.

At access doors dampers, etc., the wire netting shall be taped with aluminium foil faced tape around such fittings.

External to Plantrooms Exposed to View (No False Ceiling or Open Type False Ceiling)

All supply ductwork, where exposed to view or in open type false ceilings etc., shall be insulated as stated for plant rooms finished to Class "0" as defined in the Building Regulations or other approved.

The whole of the insulation shall have a canvas finish treated with a sealer and two coats of Idenden ET 10 fire retardant vapour seal. The scrim finish shall be taken over all ductwork support brackets. All joints shall be sealed by overlapping the canvas and treated with fire retardant vapour seal.

The finish shall be of a high quality suitable as the final finish or of accepting a further paint finish by others.

F.30.13 Ductwork - Exposed to Atmosphere

Exhaust Ductwork

Un-insulated but painted two coats black bitumastic paint.

F.30.14 Pipework Cladding– Plant Rooms and Accessible Services Risers/Cupboards

Cladding shall provide a protective covering to the insulation materials and shall be applied by a suitable specialist. The fixing materials and adhesives shall be in accordance with the manufacturer's requirements. Cladding materials shall be suitable for the location and environment.

In plant rooms and services risers, all thermal insulation shall be protected from mechanical damage by means of either aluminium cladding as supplied by Messrs Kitson Ltd, type "Hammerclad" or by PIB (polyisobutylene) or Isogenopak (PVC) cladding. Cladding shall be applied in accordance with the manufacturer's instructions by suitable specialist.

The installation of cladding shall be neat in appearance with the only breaks being at valve and equipment and service (i.e. Binder points) locations. End caps shall be formed at all cladding termination locations.

Identification bands and lettering and flow arrows shall be applied to the cladding.

F.31 PIPEWORK TRACE HEATING INSTALLATION

F.31.1 General

Where specified elsewhere pipework shall be electrically trace heated to either:

- Maintain a minimum temperature to meet requirements of ACOP L8, OR
- Provide protection against freezing

F.43 HEAT PUMP PLANT - FOR HEATING AND COOLING DUTY

The Contractor shall supply and install refrigerant based heat pump equipment as specified. The refrigerant shall be R410 or other approved refrigerant. CFC or HCFC refrigerants shall not be employed.

The installation shall be undertaken by a suitable specialist who is the manufacturers registered installer and who shall provide a full manufacturers installation warranty of at least 3 years.

The system shall provide the rated heat output at the specified heating system temperatures and in the case of air source systems this shall be achieved with an external temperature at –3 degC (minus 3 degC).

The system shall be complete with all necessary integral controls as required for automatic reliable and safe operation of the system.

The system shall be either ground source or air source type and shall comprise low-grade heat exchanger, evaporator, compressor, and condenser. Where the heat pump unit is specified as providing high grade heating water output the system shall be complete with refrigerant/water heat exchanger.

In the case of ground source systems the installation shall include subterranean low grade heat collection water pipes either horizontal pipes or vertical configuration. The installer shall undertake a survey of the area to be used for installation of external heat collection pipes and shall advise on the most appropriate method of installation. The installation shall include all work associated with the installation of external heat collection pipes such as boreholes, trenching and reinstatement.

Where specified systems with high grade heating water output shall be complete with heating water circulation pump and expansion vessel.

Where specified air source heat pump systems shall be capable of reverse cycle operation to provide cooling service either by chilled water or refrigerant cooling.

F.46 FEED & EXPANSION EQUIPMENT

F.46.1 Open Heating Systems – Residential Applications Only

Where specifically specified, heating systems shall be provided with a feed and expansion tank located with the invert of the tank located at least 1.0 m above the highest most part of the heating system including the heating pipework.

The tank shall be of suitable polypropylene construction to BS 4213 complete with lid and shall be fully thermally insulated. The tank shall be supported over the whole area of the tank base on a suitable platform supported off the building structure. The tank support shall be suitable for the maximum weight of the tank.

The boiler feed pipe shall extend from the tank, with a lockshield isolating valve located next to the tank, to connect to either the boiler return connection or direct to the boiler. There shall be no valve between the cold feed connection and the boiler.

The boiler open vent pipe shall be extended either from a direct connection to the boiler, or from the boiler flow connection and run to discharge over the feed and expansion tank. There shall be no valve connection between the open vent connection and the boiler other than approved NABIC 3-way vent cock, and there shall be no valve or restriction on the open vent pipe including any reduction in pipe size.

The open vent pipe shall be run with the minimum of sets and bends and shall be graded to rise in the direction towards the tank. The cold water feed and the expansion pipes shall not be combined or interconnected.

The feed and expansion tank shall be provided with a cold water mains feed via a ball valve connection and a suitable overflow pipe shall be run from the tank to discharge to a suitable safe external location.

The feed and expansion cisterns, boiler feed pipe and boiler open vent pipes shall be sized as follows:

Boiler Input Rating (kW)	Cistern Size (Litres)	Ball Valve Size	Cold Feed Size	Open Vent Size	Overflow Size
15	18	15	22	28	28
22	18	15	22	28	35
30	36	15	22	28	35
45	36	15	22	28	35
60	55	15	22	28	35
75	68	15	28	35	35

F.46.2 Sealed Heating Systems – Residential

Unless otherwise specified, heating and chilled water systems shall be unvented and shall be provided with expansion vessels to accommodate thermal expansion of water. Sealed heating (unvented) systems shall not be provided with feed and expansion tank.

A suitable expansion vessel to BS 4814 shall be installed and connected to the boiler by an expansion pipe. The expansion pipe shall either connect directly to the boiler or shall connect to the boiler flow connection. There shall be no valve installed between the expansion vessel and the boiler. The size of the expansion pipe shall be a minimum of 28 mm.

The expansion vessel shall be located as near to the boiler as practical in an accessible position and shall be mounted on and fixed to a secure base.

The expansion vessel shall be sized in accordance with BS 5449 and shall be capable of accepting water expansion of at least 62.5% of the vessels volume without damage. The vessel shall have a capacity to accept the expansion of the system when heated to 110º C without raising the pressure in the system to more than 0.35 bar below the lift pressure of the safety valve.

Sealed systems shall be provided with a pressure gauge to read 0 to 4 bar located in a visible position next to the boiler.

Sealed systems shall be provided with a 20 mm safety valve to BS 6759 Part 1, with a lift pressure set at a maximum of 3.0 bar and shall be either connected direct to the boiler or shall be located on or next to the boiler on the flow connection. There shall be no valve or pipeline restriction installed between the safety valve and the boiler.

The lift pressure of the safety valve shall be reduced in cases where the position of the boiler and safety valve is significantly higher than the lowest part of the heating system as follows:

Height of Boiler/Safety Valve above lowest part of Heating System	Maximum Safety Valve Lift Pressure Setting
Less than 1.5 m	3.0 bar
Between 1.5 m and 5.0 m	2.5 bar
Between 5.0 m and 10.0 m	2.0 bar

F.71 LPHW RADIATORS & CONVECTORS

F.70.1 Radiators

All radiators shall be of the welded steel panel type. Radiators shall be suitable for the test pressures of 8 Bar and have a working pressure of 5 Bar.

Radiators shall be as manufactured by Ideal, Myson Ltd, Hudevad or as specified elsewhere and equal and approved.

Radiators shall be provided with air vent cock at one top connection.

Radiator connections shall be bottom opposite ends unless otherwise indicated and 15mm female iron thread connection shall be provided for outputs up to 4.0kW and 22mm for outputs over 4.0kW.

Radiators shall be supplied with the manufacturers fixing brackets which shall be installed in accordance with the manufacturer's instructions.

Radiators shall be delivered to site suitably protected from damage. Damaged radiators shall be taken off site and replaced as necessary. The manufacturer's primer paint finish shall be touched up by the Contractor as necessary ready for final decoration by the Main Contractor.

The Contractor shall include for removing radiators after fitting for painting and decorating by others and for their subsequent reinstatement.

Where specified, each radiator shall be fitted with thermostatic radiator flow valve and lockshield return valve. Otherwise each radiator shall be fitted with flow wheel valve and lockshield return valve. Valves shall be as specified for use with radiators.

F.70.3 Towel Rails

Towel rails shall be manufactured by Vogue or as scheduled on the drawings and shall be suitable for LPHW connection. Where specified the towel rails shall be dual fuel type and be fitted with 230v electric immersion heater with integral thermostat.

The construction shall be suitable for an operating pressure of 5 bar with a test pressure of 10 bar.

Electrical connections shall be IP44 rated.

Towel rails shall be either ladder style arrangements or shall incorporate panel radiator. Finish shall be polished chrome or power coat white as specified.

Towel rails shall be fitted with suitable thermostatic control valve and shall be arranged such that the surface temperature does not exceed 50 deg C.

Towel rails shall be complete with manufacturers fixing which shall match the specified fish of the heater.

Final exposed to view pipework connections shall be in chromed pipe.

F.73 GRILLES, DIFFUSERS & LOUVRES

F.73.1 General

The Contractor shall provide and fix in position as indicated on the drawings, all necessary grilles, diffusers, and louvres, associated with the ventilation systems.

Grilles and diffusers shall be constructed from extruded aluminium or from self-colour polymer and shall be as manufactured by Waterloo Ltd. or equal and approved.

Louvres shall be constructed from extruded aluminium or galvanised steel, be complete with vermin screen and shall be as manufactured by Waterloo Ltd. or equal.

Supply air grilles and diffusers shall be provided with manufacturer's plenum box unless otherwise specified.

Supply air grilles and diffusers shall be complete with integral opposed blade volume control dampers unless otherwise specified.

All grilles, diffusers, and louvres shall be stove enamelled to BS/RAL colour to be advised.

Grilles and diffusers shall not be face fixed. Grilles and diffusers, unless specified as reverse border type, shall be provided with sub-frame fixing.

Where grilles and diffusers are specified as reverse border, frame-less or without border, grilles and diffusers shall be supplied with reverse border and the Contractor shall arrange for suitable timber framing to be provided to enable rear fixings to be made.

F.73.2 Ventilation Extract Grilles

Side-wall grilles shall be fixed blade type as detailed on the Drawings.

Ceiling grilles shall be fixed blade or egg-crate type, or matched to supply diffusers as detailed on the Drawings.

Extract air valves shall be as manufactured by Waterloo Ltd type VB.

F.73.5 Exhaust Louvres

Louvres shall be welded steel construction or extruded aluminium as specified with stove enamelled finished to BS/RAL colour to be advised.

F.80 HOT WATER CYLINDERS, STORAGE CALORIFIERS, BUFFER AND THERMAL STORE VESSELS

F.80.1 Indirect Cylinders

Indirect storage type copper cylinders shall be provided as indicated on the drawings. Cylinders shall be provided with annular heaters sized to heat the contents up to design temperature from 10 °C to the specified storage temperature in 1 hour when fed with LPHW at 80 °C flow and 60 °C return. The cylinders shall store water at 60 °C.

Each cylinder shall be constructed to BS 1566 Part 1, Grade 2 and be suitable for a working primary and secondary static pressure of 5.0 Bar with a test pressure of 10.0 Bar.

Where un-vented cylinders are specified, these shall be complete with expansion vessel and safety valve. The expansion vessel shall be sized to ensure the HWS secondary pressure does not exceed then cold fill pressure by more than 1 Bar.

Each cylinder shall be supplied complete with de-stratification pump and top/bottom interconnection pipe work to ensure that full compliance with ACOP L8 is achieved. The pump shall be pre-wired as part of the cylinder package and shall be arranged to operate continuously.

HWS secondary return network shall be provided to minimise 'dead legs' to ensure that hot water is available at all draw off points and to comply with the requirements of the Water Board. The return circuit shall be designed to ensure a circulation temperature drop of more than 10 °C between flow and return connections at the cylinder does not occur.

Each cylinder shall be properly supported on a ventilated base and it shall be the Contractors responsibility to ensure that all supports are approved by the Architect/Structural Engineer prior to installation.

F.80.4 Buffer Vessels

This specification is for vessels used in conjunction with heat exchangers as a means of generating domestic HWS.

Buffer Vessels shall be provided as indicated on the drawings. Vessels shall be constructed with copper or stainless steel shell. Each vessel shall be constructed to BS 853 and be suitable for a working static pressure of 7.5 Bar with a test pressure of 15.0 Bar.

Each Vessel shall be complete with busting disc, pressure and temperature gauges, and NABIC safety valve.

Where specified vessels shall be factory fitted with de-stratification pump and associated pipe work.

Each vessel shall be supplied with manufacturer's legs or cradle as appropriate for vertical or horizontal arrangement. It shall be the Contractors responsibility to ensure that all supports and fixings are approved by the Architect/Structural Engineer prior to installation.

The vessel shall be provided pre-insulated with a paint finished outer mild steel casing to protect the insulation material.

In addition to the secondary side flow and return connections, each buffer vessel shall be provided with cold feed connection and flow and return transfer connections to interface with the plate heat exchanger.

F.81 RESIDENTIAL UNVENTED INDIRECT DOMESTIC HWS CYLINDERS

The cylinder shall be located within store/cupboards in each Flat as indicated on the drawings. The Contractor shall note that hot water services pipe work runs shall be kept as short as possible and in any case shall not exceed the permitted maximum for a dead leg.

The cylinder shall be designed for unvented applications and shall be supplied complete with non-return valve and inlet pressure limiting valve on the cold mains water connection, direct acting pressure relief and over-temperature relief safety valves, and expansion vessel design to absorb the contents of system expansion without raising the system pressure above 2.65 bar. The over-temperature safety valve shall operate to prevent the possibility of the stored water temperature rising to 100ºC.

A strainer shall be installed on the mains water connection to the cylinder upstream of all control devices.

The discharges from the pressure relief and over-temperature relief safety valves shall be collected via a tundish with trapped outlet and extended in copper pipe to discharge in a safe position to nearest available soil stack position or as otherwise agreed.

A stop cock shall be provided on the mains water connection to the cylinder.

A temperature gauge shall be fitted to indicate the temperature of the secondary water at the top of the cylinder.

Cylinders shall have brazed copper secondary shell with primary LPHW helical copper coil to provide a maximum heat up from cold of one hour. The cylinder arrangement shall be vertical type and shall be complete with sacrificial magnesium anode.

The cylinder shall be complete with connections as follows:

2 x 25 mm primary heating
1 x 25 mm cold water feed
1 x 25 mm HWS flow
1 x 15/22 mm drain cock
1 x Immersion Heater

Cylinders shall have a working pressure rating of 5 bar minimum and a test pressure of 10.0 bar.

Cylinders shall be pre-insulated with approved fire retardant closed cell foam.

Cylinders shall be supplied complete with 3 kW short reach top mounted electric standby immersion heater complete with integral thermostat.

Cylinders shall be supported on a rigid horizontal timber base designed to accept the weight of the cylinder when full of water. The cylinder shall be positioned to allow access to all connections. The drain cock shall be complete with hose coupling and shall be in a suitable position to allow easy drain down.

F.91 PRESSURISATION UNITS

The boiler make-up/pressurisation units shall comprise feed tank, duplex pressurisation pump, pre-wired controls and control panel, all necessary integral starters, contactors and relays, high and low pressure safety switches and all necessary controls equipment to comply with the Health and Safety Executive Guide Note PM5, including necessary interlocks with the boiler control and chiller control circuits. The unit shall be approved by the Water Authority and comply with all relevant regulations.

The unit shall be as manufactured by Armstrong Ltd type 3750 Pulpress or equal suitable for systems with working pressures up to 10 Bar.

The safety high pressure limit and low pressure limit sensors shall be interlocked with the boiler control circuits or chiller control circuits as appropriate, such that the electrical supply and the boiler control circuits are isolated and alarm circuits activated whenever the system pressure goes out of limits.

Automatic reset of these safety control circuits shall not be provided.

Each set shall comprise one or more expansion vessel(s) and one pressurisation unit all mounted on common steel base frame.

The expansion vessel shall be of the membrane type manufactured to BS EN 13831 type 'Expansomat Standard' suitable for a test pressure of 10.0 bar supplied pre-charged as required and suitable for a working temperature up to 100°C and a maximum system working pressure of 5.0 bar. The maximum pressure at the highest most point of the LPHW system shall not exceed 1.0 bar above atmospheric pressure. Each vessel or range of vessels shall be provided with spring release safety valve of the NABIC pattern.

The Contractor shall install pressurisation plant strictly in accordance with the manufacturer's recommendations and all necessary ancillary equipment needed for the reliable and satisfactory operation of the systems, such as air separators, automatic air vents and anti-gravity loops shall be installed.

The unit shall be complete with control panel to house pump starters, run and trip lamps, pump lead/lag change-over switch, main incoming supply isolator, system pressure gauge, high and low pressure indication lamps alarm bell, mute switch and alarm muted indicator lamp, panel alarm lamp, all necessary fuses relays and safety locks.

F.101 FIRE & SMOKE CONTROL SERVICES

F.101.1 Self-Acting Fire Dampers

Fire dampers shall be provided and installed in accordance with the Building Regulations and HVCA Ductwork Specifications to the positions indicated on the Design Drawings.

Fire dampers shall be installed in ductwork where ductwork passes through fire walls, ceiling void smoke barriers and floor slabs, to give a minimum of 2 hour fire rating and these shall be as manufactured by Messrs Actionair.

Fire dampers for duct sizes up to 150 x 150 and 150 dia. shall be intumescent type as Actionaire TransShield ACS. Fire dampers for lager duct sizes shall be stainless steel curtain type with curtain held out of the airstream as Actionaire type FireShield E.

Activation shall be by spring and/or gravity with the curtain held back by approved fusible link. Fusible links shall have a rated melting point temperature of 165 deg. F / 74 deg. C unless otherwise specified.

Fire damper shall wherever possible be positioned within the thickness of the structural material forming the fire/smoke barrier. If this is not possible a short section of 2 hour rated fire resisting ductwork shall be extended through the structure to a position where the fire damper can be positioned and the fire damper shall be installed and protected within the fire resisting duct. The distance from fire damper to fire/smoke barrier shall be a minimum. The Contractor shall use the appropriate Actionaire mounting kit to suit application.

The Contractor shall ensure the installation provides no breach of the integrity of the fire/smoke barrier and suitable approved packing and grouting materials shall be employed to provide a fire seal between the damper casing (or fire resisting ductwork if applicable) and the structural opening. Expanding foam shall not be used.

Access doors shall be provided in ductwork adjacent to each fire damper. Access doors shall be in accordance with DW/144 and as manufactured by Actionair. Where ductwork is installed within ceiling voids and builderswork enclosures, access panels shall be provided to enable access to the fire damper access panels.

F.101.3 Automatic Opening Smoke Relief Vents (AOVs)

Not Applicable

F.101.4 Fire/Smoke Curtains

Fire/Smoke curtains shall be provided as indicated on the drawings and shall be supplied and installed by the Main Contractor unless specified otherwise. Curtains shall either be of the mattress type with weight supported from soffit or by means of fire rated barrier wall constructed of suitable fire rated panels and framing.

Fire/smoke curtains shall be located within ceiling and floors voids in accordance with Building Regulations and shall provide a minimum of 2 hour fire rating and be designed and constructed to prevent smoke penetration.

Where ventilation ductwork is required to penetrate the fire/smoke curtain a suitable automatic fire/smoke damper shall be located at each barrier position or alternatively fire rated ductwork may be used between curtain positions subject to Building Control approval. Fire/smoke dampers shall be installed within a section of fire rated ductwork extended beyond both sides of the curtain to prevent any breach of the barrier. Fire/smoke dampers and associated fire rated duct shall be supported both sides of the curtain.

F.101.5 Fire Rated Ductwork and Fire Rated Ductwork Cladding

Fire rated ductwork shall be either ductwork constructed of fire resisting material or standard ductwork externally clad in a fire resisting material. In both arrangements the installation shall meet the requirements of the Building Regulations and provide at least 2 hour fire resistance to the duct from a fire external to the duct. Fire rated ductwork shall additionally be 2 hour rated for a fire both within and external to the duct.

Fire rated ductwork shall be as constructed utilizing either Flamebar BW11 material as manufactured by Firespray International or Durasteel as supplied by Invicta Fire Protection. Fire rated ductwork shall be constructed and installed by a suitably Specialist in accordance with the manufacturer's instructions.

Fire rated duct cladding shall be supplied and installed by approved Specialist utilizing mineral wool slab material fixed to the exterior of the duct as Firepro manufactured by Rockwool. The cladding material shall be fixed to the duct using the manufacturer's welded pin fixing method.

Ductwork fixings and supports shall be designed to be fire rated to at least the specified fire rating of the ductwork and shall be designed to accommodate the additional weight of the fire rated ductwork.

The Contractor shall adhere to the recommendations of Specialist suppliers and fabricators to ensure the performance of the installation meets the specification requirements.

Where the position of a fire or smoke damper is to be located outside the fire barrier structure (see fire dampers above), the ductwork extension between fire damper and structure must be by use of fire rated ductwork (cladding is not suitable for this application).

F.101.6 Automatic Fire and Smoke Detection and Alarm Services

See Specification Section E for details of requirements.

SECTION G TECHNICAL SERVICES & SPECIALIST INSTALLATIONS

G.1 SCOPE

The complete Specification, appendices thereto, and the accompanying design drawings, when read together, set out the complete contract requirement with regard to the Services Installation.

This section of the Specification describes the Technical Services and Specialist Installations relating to the Services Installation.

The design drawings and Specification shall form a single entity, be complementary to each other and all items shown or described in either or both shall be provided within the tender sum.

The requirements of Section I shall be adopted by the Services Contractor wherever applicable to the installation of Electrical, Mechanical and Sanitation Services whether or not specific reference to this Section is made elsewhere.

Section I is common to both Electrical and Mechanical Services Installations. Where Section I applies to a Sub-Contract comprising Electrical and Mechanical Services Works all clauses shall be adhered to. Where the Sub-Contract comprises either Mechanical Services Works or Electrical Services Works, any reference to materials and/or workmanship of elements of the installation that are obviously outside of the scope of this particular Installation, shall be disregarded.

Section I details the requirements for Specialist Works, which shall be undertaken by suitably experienced and qualified operatives. Where the Services Contractor does not have the required level of expertise in-house, the Services Contractor shall engage suitable approved Specialist Contractors to undertake these works.

The Services Contractor shall be responsible for all aspects of the performance of Specialist Contractors employed by him. All work shall be carried out in accordance the requirements of the complete Speciation and accompanying Drawings.

The Services Contractor shall clarify any concern regarding the relevance or interpretation of any clause in this section during the Tender Stage. Thereafter the Services Consultant shall determine whether or not requirements under this Section shall be adopted as part of the Works.

G.2 SERVICES CONTRACTOR'S DESIGN

G.2.1 Performance Specifications – Design by Services Contractor

The Services Contractor shall be responsible for providing a Design Service as part of the Works in all cases where the Mechanical, Electrical and Sanitation Services Specifications and associated Design Drawings are issued as "Performance Specifications" for either the whole or part of the Services Installations.

The Services Contractor shall immediately notify the Services Consultant to seek further instruction if, for any reason, the design cannot fully comply with the requirements of this Specification.

The design shall be strictly in accordance with all the requirements of this Performance Specification, all relevant Local Authority and Statutory requirements and Regulations, the recommendations of the current edition of the CIBSE Guide, BS 7671, all relevant British Standards and Codes of Practice and the current Building Regulations. Installations in residential buildings shall additionally comply with Building Regulations guidance document "Domestic Building Services Compliance Guide 2013".

The design shall be in accordance with all relevant Energy Conservation and Management Regulations which are required under Planning Regulations and Building Regulations including the MEES (Minimum Energy Efficiency Standard) Regulation 2018.

The Services Contractor shall ensure only suitably qualified and experienced personnel are engaged upon the design work. If suitable in-house resource is not available, the Services Contractor shall employ a suitable approved specialist to undertake the design.

Performance Specifications which shall include the Design Drawings (where provided) provide the design intent and performance requirements which shall be adopted by the Services Contractor in the development of the Detailed Design of the Services Installation.

The design shall be a full design of the Building Services Installations, including all necessary Scheme Layout and Diagrammatic Drawings, Technical and Equipment Specifications to fully detail the proposed installation.

The design developed by the Services Contractor shall not include any plant, equipment or components, which cannot be obtained in equivalent from at least 2 companies other than as specified.

The Services Contractor shall ensure that appropriate design engineers are available as may reasonably be required by the Architect to attend Design Team Meetings.

The Services Contractor shall issue all design information for the approval/comment of the Architect and Services Consultant. The Services Contractor shall make any adjustments/modifications as required by the Services Consultant in good time, to enable works on site to proceed in accordance with the Main Contractors program.

The Design shall include:

- Details of all builderswork required to facilitate the installation of the Mechanical and Electrical Services Installations
- Details of the operating weights of major plant items and proposed methods of fixings/support
- Details of access doors and panels required for maintenance and equipment replacement
- Details of distribution routes of services systems including electrical conduit/trunking/trays, pipework and ductwork
- Calculations to determine requirements for main incoming services (gas, water, and electricity)
- Full calculations of the heating, domestic water, comfort cooling and ventilation services.
- All calculations and submissions as required to establish compliance with the Building Regulations including SAP and ISBEM calculations
- Where specified calculations to establish compliance with Energy Codes
- Calculations of the electrical design showing compliance to BS 7671
- Description of operation of Automatic Controls Systems including schematic and schedules
- Fire safety strategy with details of fire and smoke control measures
- Calculations to establish compliance with Fire Alarm Systems as BS 5839

- Calculations to establish compliance with specified Lighting levels including Escape Lighting
- Risk Assessment calculations to establish requirements for Lightning Protection
- Schedules of all equipment with full specifications
- Full engineering specification and coordinated design drawings and wherever required substantiating calculations, to fully describe and specify the building services systems which form the sub-contract works.

G.2.2 Services Contractor's Design Responsibility

The Technical Specification together with the Design Drawings set out the principles of the design to be adhered to by the Services Contractor throughout the Contract.

Where an element of the Works is provided with a Performance Specification, the Services Contractor shall employ a suitable Specialist to design and install the engineering systems to comply with the stated performance requirements. The Services Contractor shall take responsibility for the design and performance of all elements of the Works where Performance Specifications are provided. The following elements of the Services Installation Works, inter alia, are provided with Performance Specifications.

Automatic Controls System and Associated Electrical Installations
Fire Alarm Installations
Lightning Protection
Intruder Alarm Systems
Refrigeration Pipework Networks
Fire Protection and Fire Fighting Systems

The Services Contractor shall take the design responsibility for the manufacture, fabrication, erection and installation of specialist works such as fixings and brackets in so far that such works are required to meet the requirements of this Specification and to be fit for the purposes intended.

The Services Contractor shall take full design responsibility for the content of the Builderswork and Working Drawings. Where dimensions and details have been abstracted from other sources, it shall be the Service Contractor's responsibility to ensure that he is working to current and approved information. Wherever possible, the Services Contractor shall check all such information by taking site dimensions.

G.2.3 Fan and Pump Heads

The Services Contractor shall be responsible for specifically bringing to the attention of the Services Consultant all adjustments to the routing of pipework and ductwork services shown on the Design Drawings which may be found to be necessary as a result of the Services Contractor producing his Installation Drawings or as the result of on-site adjustments. The Services Contractor shall provide this information in good time to enable the Services Consultant to evaluate the effect of such modifications in terms of pump and fan duties and to issue, if necessary, instructions to vary the specification of the pump and fan equipment without causing delays to the required procurement of such equipment.

G.2.4 Motorised Control Valves

The controls specialist shall, under this sub-contract and under the responsibility of the Services Contractor, determine the sizes, characteristics and specifications for all motorised control valves, which are required to achieve the specified operation of the various engineering systems as specified elsewhere in this Specification. The design of the various hydraulic systems and the specifications of the pumping equipment is based upon assumed control valve characteristics. It shall be the responsibility of the Services Contractor to fully schedule the proposed selection of motorised control valves giving performance details for the approval of the Services Consultant.

G.2.5 Electrical Equipment Schedule

The Services Contractor shall produce a schedule of all plant and equipment to be supplied under this Contract, which requires an electrical supply. The schedule shall be based on information provided by the manufacturer/supplier for the equipment for this installation. The schedule shall provide the following information regarding each supply required to each item or plant or equipment:

- Equipment/Plant reference
- Number of supplies required to plant/equipment
- Voltage and whether Single Phase/3 Phase
- Frequency of supply
- Maximum Power Rating in kVA
- Maximum run current
- Starting motor current
- Recommended fuse/mcb protection rating/type
- Recommended method of local isolation
- Recommended supply cable size/type
- Method of starting motor
- Power factor

The schedule shall be issued to the Services Consultant at the earliest opportunity and in any case prior to commencement of Installation Works.

G.2.6 Fixings

The Services Contractor shall be responsible for the provision of all fixings of all pipework, conduit, trunking, ductwork, plant and equipment. The method of fixing to the structure is to be agreed with the Structural Engineer prior to commencement. The Services Contractor shall provide all necessary steelwork for the independent support of mechanical and electrical services.

Drawings of all purpose-made fixings shall be submitted to the Structural Engineer and Services Consultant for approval prior to manufacture. All purpose-made fixings shall be manufactured at works and be provided to site with a coat of zinc chromate paint. The Services Contractor shall maintain the chromate finish during the Contract. Rusty fixings will not be accepted. External fixings and supports shall be fabricated from galvanised steel or stainless steel.

G.3 SERVICES CONTRACTOR TO SURVEY EXISTING SERVICES

G.3.1 General

Where specified, the Services Contractor shall undertake all necessary surveys of existing services, both within retained buildings and in-ground in the vicinity of new construction works as detailed in Section C and below.

The Services Contractor shall employ suitably qualified and experienced survey specialists to undertake these works and shall on completion provide comprehensive electronic and hardcopy reports on condition and routing of existing services which shall be issued to the Architect/Contract Supervisor together with relevant recommendations for repair, relocation, diversion or renewal as appropriate.

The survey work shall be completed in accordance with the construction program, which shall allow sufficient time for Design Team response and instructions.

G.3.2 Scope of Works

The Services Contractor shall undertake surveys in the following instances:

In ground survey to identify any existing buried pipe or cable services or underground tanks and equipment in the area of new construction works including a peripheral margin of 3m.

Where existing services are to be retained and reused, the Services Contractor shall survey the existing services in the vicinity of all proposed new works to determine detailed requirements for such works as diversions, modifications, extensions, interconnections and adaptations.

In all cases where existing in-ground drainage systems are to re-used in part or in full, the Services Contractor shall carry out a complete survey of the entire drainage system up to and including the sewer connections, sewage treatment equipment and septic tanks as applicable.

G.3.3 In-Ground Survey in Vicinity of New Construction Works

In ground survey to identify any existing buried pipe or cable services or underground tanks in the area of new construction works including a peripheral margin of 3m.

The survey shall employ 3D imaging techniques to identify all pipework, cables and underground tanks to a depth of 3m below ground level. Generally survey shall be by GPR (ground penetrating radar). However other scan systems shall be employed such as EMC (electromagnet conductivity) and metal detection as dictated by ground conditions and where required to provide enhanced imaging.

The survey shall identify both metal and plastic pipes and tanks and shall distinguish between live and dead cables. The size of pipes and tanks and the depths shall be identified.

G.3.4 Survey of Services Within Existing Building

Not Applicable

G.3.5 Survey of Existing Drainage Systems

Buried and suspended drains shall be surveyed to determine condition, line and level. The survey shall include CCTV inspection of all pipework and visual inspection of manholes/access positions and interceptor traps.

Invert levels and cover levels shall be provided for all manholes and these shall be related to an agreed datum level.

The external condition of suspended drains shall be surveyed.

The survey shall include a full schedule of defects, which shall indentify the location of all defects and shall provide recommendations for repair/renewal as appropriate.

G.3.6 Survey Reports, Drawings, Photographs and Video Files

All survey reports shall be provided in both electronic format and hard paper copy (Services Contractor to allow to issue 4 copies of both).

All drawings shall be presented in Autocad and/or PDF format as appropriate and issued on DVD disk.

CCTV video files shall be mpeg format and issued on DVD disk.

GRP scan results shall be analysed and interpreted by survey specialist before issue to ensure results are unequivocal and readily understood.

All photographs used to provide further survey information shall be digital format (jpeg files) and issued on DVD disk.

All survey information shall be collated and indexed and all elements of the information shall be clearly labelled with Project Name, Surveyors Name, Date, Location, and Detail.

G.5 SERVICES CONTRACTOR'S DRAWINGS

G.5.1 General

The following drawings shall be prepared by the Services Contractor and be submitted in both paper (hardcopy) form and in electronic form (DXF or PDF) for the approval of the Architect and Services Consultant.

The cost of the preparation and reproduction of these drawings shall be met by the Services Contractor.

All drawings shall be prepared and submitted within a reasonable time in relation to the progress of the works.

The Architect and Services Consultant shall be allowed a minimum period of 10 working days from the actual receipt of the Services Contractors drawings to complete the checking exercise and the return the drawings to the Services Contractor. Subsequent issues of amended drawings for the approval of the Architect and Services Consultant shall be similarly processed.

It shall be the responsibility of the Services Contractor to verify the accuracy of all dimensions. Wherever possible the Services Contractor shall take physical measurements.

G.5.2 Builderswork Drawings

Within an agreed time of the Contract order being placed, and in accordance with the agreed Main Contractor programme, the Services Contractor shall provide all necessary Builderswork Drawings related to his work.

Builderswork Drawings are to be submitted to the Architect, Structural Engineer and Services Consultant for approval and when amended and approved by the Architect for Construction, the Main Contractor shall issue these drawings to all interested parties.

The Services Contractor shall not commence the installation of Mechanical and Electrical Building Services Works until such time that the Services Contractor's Builders Work Drawings have been approved for Construction.

The drawings shall detail to a suitable scale all Builderswork required in connection with the Electrical and Mechanical Services Installation. In general all builderswork requirements including holes and chases in walls, floors and beams and the necessary making good shall be the responsibility of the Builderswork Contractor. The Builderswork shall also include any additional works to ceilings, wall and floor finishes, and the structure of the building including timber, RC and steel frame, the brickwork, block work and stud work as may be detailed on the drawings forming part this Contract.

G.5.3 Installation Drawings

Installation Drawings are to be submitted to the Architect and Services Consultant for comment and approval and when amended and approved by the Architect for Construction, the Main Contractor shall issue these drawings to all interested parties.

The Services Contractor shall not commence the installation of Mechanical and Electrical Building Services Works until such time that the Services Contractor's Installation Drawings have been approved for Construction.

If work on site should proceed either before Installations Drawings have been approved for Construction, or in contradiction to the Installation Drawings, then the Services Contractor if instructed, shall remove such work at no cost to the Employer and at no implication to the Contract Programme.

The Services Contractor shall prepare fully co-ordinated Installation Drawings of all areas of the building to fully detail the proposed Mechanical and Electrical Services Installation including floor layouts, plant rooms, service ducts and risers, and suspended ceiling voids. The Installation Drawings shall demonstrate the proper coordination of the services with the building fabric and structure.

The Services Contractor shall provide Diagrammatic Drawings of the air and water distribution networks, the automatic control systems, the electrical distribution network and the distribution boards.

All congested areas shall be drawn to a suitable scale of not less than 1:20.

Additionally, the Services Contractor shall prepare Installation Drawings where variations to the Contract occur to details furnished by the Services Consultant.

Installation Drawings shall comprise accurately dimensioned detailed plan, elevation and section drawings of plant, equipment, pipes, ducts, conduit, trunking and other details of the Services Contractor's works to amplify the information provided on the Design Drawings. The Services Contractor shall provide details of fixings to structure, the location of all access positions for servicing/maintenance and plant installation/replacement and details of all equipment related to the services installation where this is supplied or constructed by others such as external weather louvres, builderswork ventilation shafts etc.

Installation Drawings shall contain details of structure and services, which form part of Other Contractors works, where such details are relevant to the routing or fixing of services under this contract.

G.5.4 Progress Drawings

The Services Contractor shall keep on site one set of services drawings to show the progress of the work. The progress drawings shall be continuously updated to detail the current status of installed works and shall also identify any modifications and variations to the Construction Drawings. These drawings shall not be used for any other purpose.

In addition the mechanical services drawings shall indicate pipelines, air ducts, valves, plant and equipment.

In addition, the drainage drawings shall indicate the line and level of all installed drains, manholes, and inspection chambers and the above ground sanitation drawings shall indicate the dimensioned plan position of all stacks and rainwater pipes at each floor level.

In addition the electrical services drawings shall be shall record all primary cable tray and trunking routes, any horizontal or angled cable/conduit routes fixed to walls and any circuit changes instigated at site level.
The progress drawings shall be available for inspection at any time by the Architect, Services Consultant or the Client's Project Manager.

G.6 ACOUSTIC SERVICES

G.6.1 General

Where specified, the Services Contractor shall engage a suitable specialist to undertake an environmental noise level survey at the site location prior to commencement of Contract Works.

The Services Contractor shall purchase acoustic treatment and anti-vibration equipment from a suitable specialist supplier as AES Ltd or equal approved.

Each item of plant and equipment shall be reasonably silent in operation. In particular, no significant degree of noise or vibration shall be discernible outside plant rooms or in spaces where plant or equipment is housed.

The Services Contractor shall provide acoustic/anti-vibration treatment to all central plant and equipment, pipework and ductwork systems as necessary to achieve the specified criteria due to duct borne, structure borne, and air based noise.

The installation of acoustic treatment and vibration control appliances shall be as in accordance with equipment manufacturers' recommendations/requirements and specified under particular plant and equipment specification clauses and in any case as required to meet the design criteria as set down in Section D of this Specification.

The Services Contractor shall provide acoustic/anti-vibration treatment to all central plant and equipment and to pipework and ductwork systems as necessary to achieve the specified room and external noise levels and to prevent the transmission of vibration to the structure.

The Services Contractor shall provide sound absorbing and/or anti-vibration materials or devices as necessary to achieve a satisfactory degree of silence in operation.

All pipework and equipment fixings to structure within plant areas shall be provided with anti-vibration material between structure and fixing.

Pumps shall be provided with flexible pipework connections.

The Services Contractor shall ensure the installation of pipework is arranged such that no noise or vibration is generated under normal operating conditions. Pipe clips shall have neoprene inserts.

G.6.2 Environmental Noise Level Survey

Where specified, the Services Contractor shall engage a suitable specialist to undertake an environmental noise level survey at the site location prior to commencement of Contract Works and shall report findings to the Architect or Services Consultant as appropriate.

The results shall be presented in a comprehensive report, which shall be suitable to submit to the Planning Authority to establish whether or not any proposed changes to the building or services will result in noise levels exceeding the Local Authority's requirements.

The Noise Level Survey Report shall also detail what acoustic measures if any are required to ensure compliance with the Local Authority's requirements.

The location of the test position(s) shall be agreed with the Architect and shall in any case be appropriate for the purposes of the test.

The survey shall be continuously conducted over a 7-day period or as otherwise agreed. The test procedure and methodology shall be consistent with the requirements of the relevant Local Authority.
Test equipment shall be consistent with BS4142 and shall certified as correctly calibrated by BSRIA or other recognised specialist agency.

Noise level recoded shall be filtered using the A weighted acoustic filter and the period of individual averaging time shall be set to 20 minutes. The survey shall record the following information:
LA1, LA10, LA50, LA90, LA99, and LAeq.

G.6.3 Ductwork Acoustic Attenuators (Silencers)

Acoustic attenuators shall be provided in the systems as required to control the transmission of airborne noise. The acoustic performance of the attenuators shall ensure the requirements of Section D of this Specification are met or exceeded.

Attenuators shall be of the sizes and shall be as located as indicated on the drawings and shall be as manufactured by AES Ltd or equal and approved.

Wherever possible attenuators shall be built into floor and wall structures to prevent noise flanking. Attenuators shall not be located within or built into fire compartment walls and floors. The builderswork opening shall be acoustically sealed to the attenuator with heavy density packing/sealant.

In line attenuators shall be provided where necessary, generally in conformation to the requirements of HVCA ductwork specification DW142.

The acoustic performance of attenuators shall be tested to BS EN ISO 7235, BS EN ISO 140 and BS EN ISO 10140.

Attenuators shall be constructed from the best quality galvanised sheet steel of minimum 0.8mm thickness throughout and additionally stiffened with galvanised steel sections to prevent drumming/flexing. All joints shall be lock formed and mastic filled during manufacture.

Attenuators shall be of the low-pressure drop design with radiused aerodynamically profiled bull nosed fairings applied to leading and trailing splitters ends.

The acoustic absorption material shall be tested to Class 1 Spread of Flame to BS 476, and shall be inorganic, non-hygroscopic, moisture and vermin proof mineral fibre infill sections faced with minimum thickness of 0.8mm perforated galvanised sheet steel with a polyester membrane beneath for protection against grease and as a deterrent to bacteriological growth.

Ductwork connections shall be in accordance with the ductwork installation and shall be spigot, r.s.a. flange, Mez or Ductmate profiled flange. Connections shall be suitable for the design system pressures.

Ductwork connections to attenuators shall be by means of ductwork transitional sections which shall provide a gradual change in section from ductwork profile to attenuator profile and the maximum change of section angle shall not exceed 22.5 deg.

G.6.4 Flexible Pump Connectors

The Services Contractor shall provide acoustic/anti-vibration treatment to all central plant and equipment, and pipe work systems as necessary to achieve the specified criteria due to structure borne noise.

Flexible Connectors shall be installed on all final pipe work connections to pumps. Where installed on the suction side of pumps, connectors shall be complete with anti-vacuum rings. Connectors shall be selected with a suitable test pressure for the application.

Flexible pipe work connections shall be as manufactured by Mason Industries Ltd and supplied by Mason UK Ltd. Flexible pipe work connections shall be neoprene type MFNC complete with flanges.

G.6.5 Flexible Hose Connections

The Services Contractor shall provide acoustic/anti-vibration treatment to all central plant and equipment, and pipe work systems as necessary to achieve the specified criteria due to structure borne noise.

Flexible Hose Connections shall be installed on all final pipe work connections to all equipment containing reciprocating and rotational machinery and which is subject to vibration and movement such as compressors, water chillers, ventilation equipment and pumps/water boosters. Connectors shall be selected for the maximum possible temperatures and pressures of the system and in any case shall be suitable for temperatures of 105ºC and for pressures of 10 bar.

Hoses shall be manufactured of multiple plies of nylon tyre cord fabric and neoprene both braided and cured in hydraulic rubber presses. No steel wire or rings shall be used as pressure reinforcement. Hose connectors up to 42mm shall be threaded and over 42mm these shall be flanged. Hose connectors shall be installed on the equipment side of isolating valves.

The performance of hose connectors shall provide a minimum of 20dB reduction in vibration acceleration and 10dB reduction in sound pressure levels at typical blade passage frequencies.

Flexible pipe work connections shall be as manufactured by Mason Industries Ltd and supplied by Mason UK Ltd. Flexible pipe work connections shall be neoprene type MFTFU and MFTNC complete with flanges.

G.6.6 Anti-Vibration Spring Plant Mountings

Spring mountings shall be provided to isolate all plant and equipment prone to vibration generation from the building structure such as pumps, chillers, ventilation plant, and compressors. Wherever anti-vibration mounts are utilised, flexible pipe work connections shall be used on all pipe work connections to the equipment and flexible conduit shall be used on all electrical connections to the equipment.

Anti-vibration spring mounts shall be as manufactured by Mason Industries and supplied by Mason UK Ltd. with 25mm deflection springs designed to provide at least 90% isolation efficiency. Mountings used in external locations shall be fully enclosed type and finished to resist corrosion.

Anti-vibration mountings shall be positioned in accordance with the plant manufacturer's recommendations and selected for the maximum operating weight and vibration characteristics of the plant.

G.6.7 Anti-Vibration Pipe and Equipment Hangers

Spring hangers shall be used to support pipe work and pipeline equipment on pipe runs within 10 m of connected plant.
Anti-vibration pipe and equipment hangers shall be as manufactured by Mason Industries and supplied by Mason UK Ltd. Anti-vibration hangers shall be type 30N and PC30N.

Hangers shall be selected for the working weight of pipe work and equipment and these shall be installed in accordance with the manufacturer's recommendations.

G.6.8 Flexible Ductwork Connections

Flexible ductwork connections shall be provided as necessary and in particular at connections to all plant/equipment containing reciprocating or rotating machinery.

Flexible ductwork connections shall be as manufactured by Messrs Hardura Ltd, type BM.1180, with sewn joints and shall have a minimum effective length of 100 mm.

G.6.9 Pipework Systems

Flexible pipework connections shall be provided as necessary and in particular at connections to all plant/equipment containing reciprocating or rotating machinery. Flexible connections on the suction side of pumps shall be provided with anti-vacuum rings.

Pipework systems shall be provided with anti-vibration flex connections to isolate pipework from structure where pipework leaves/enters plant rooms. Flex connectors shall be as manufactured by Masons Industries Ltd and supplied by Mason UK Ltd type MFTFU and be suitable for the system pressure.

Flex connections shall be installed such that these shall not take any strain from the weight of pipework or equipment nor shall the connections be used to correct misalignment of pipework and equipment.

All pipework in plant rooms connected to pumping plant shall be supported on anti-vibration hangers of the spring and /or spring/neoprene type.

All pipework and equipment fixings to structure within plant areas shall be provided with anti-vibration material between structure and fixing.

The Services Contractor shall ensure the installation of pipework is arranged such that no noise or vibration is generated under normal operating conditions. Pipe clips shall have neoprene inserts.

Pipe sleeves shall be employed wherever pipes pass through floor and walls and other structures and the pipe shall be caulked into the sleeve to prevent metal to metal contact. Plastic pipe sleeves shall be employed where pipes are routed through notches in timber floor joists.

G.6.10 Plant

All plant/equipment containing reciprocating/rotating machinery shall be isolated from the structure by means of anti-vibration mountings. These shall be either rubber-in-shear or enclosed spring mount types to suit application.

All connections to the equipment including ductwork, pipework and electrical conduit shall be provided with flexible connections to prevent vibration transmission.

The additional requirements of equipment manufacturers shall be adhered to.

G.7 BUILDERSWORK

The Services Contractor shall be responsible for producing dimensioned Builderswork Drawings which set out the accurate position of all builders work requirements and for the marking up on site of positions of floor and wall holes and chases. Work shall not proceed until Builderswork Drawings are approved in writing by the Architect.

Builderswork required in connection with the installation of mechanical and electrical services shall be carried out by the Main Contractor with the exception of chasing for electrical conduit and accessories and holes through structure up to 50mm, which shall be undertaken by the Services Contractor. All cutting away through floors, walls and ceilings for the passage of pipes and making good after, the formation of subways, trenches and ducts, the construction of bases for plant such as chillers, boilers, cylinders, pumps, and the cutting out for and building in of all supports shall be carried out by the Main Contractor.

The Services Contractor shall be responsible for the marking up on site of all positions of floor and wall holes and chases for the approval of the Architect.

The Services Contractor shall check the accuracy of all builderswork carried out by the Main Contractor and report any discrepancies prior to the commencement of the installation of service.

The Builderswork Contractor shall carry out the making good around services where these penetrate structure and building finishes to the instructions of the Services Contractor. The Services Contractor shall detail such making good works taking due account of thermal movement, vibration, future service replacement/maintenance, the support and fixing, and requirements for fire stopping.

The Services Contractor shall include in his Tender for all necessary plugging of walls for fixing of screws for any item of plant forming part of the specified installations.

G.8 BRACKETS & GANTRIES

The Services Contractor shall fabricate, erect and fix in position as required all necessary brackets, gantries and supports required for the independent support and fixing of pipework, ductwork, plant and equipment.

Brackets, gantries and supports shall be constructed from mild steel angle/channel section with welded or bolted joints, prefabricated off site and shall be galvanised after manufacture where located in external positions.

All holes for fixing down bolts and service supports shall be drilled. Where brackets are galvanised after manufacture, all bare metal exposed by site drilling shall be protected by cold galvanising paint.

Mild steel brackets shall be wire brushed and painted one coat zinc chromate primer at works. Further protective painting at site and the final decoration of all brackets, gantries and supports shall be provided as specified elsewhere.

All brackets and gantries shall be suitably constructed to support the final operating weight of services and to withstand the forces imposed by thermal expansion/contraction. The Services Contractor shall submit drawings of all brackets, gantries and supports to the Services Consultant for information and comment prior to manufacture. All brackets and gantries shall be properly aligned and where necessary graded to suit the requirements of the pipework installation. Brackets shall be designed to provide a minimum pipework drop rod length of 250 mm.

The Services Contractor shall be responsible for ensuring that the fixing of all brackets and gantries to the structure is satisfactory and approved by the Structural Engineer prior to fabrication.

Where pipework anchors and guides are required, the Services Contractor shall submit full details of the proposed bracket including details of thrust forces to the Services Consultant for consideration prior to installation.

The Services Contractor shall take the design responsibility for the manufacture, fabrication, erection and installation of specialist works such as fixings and brackets in so far that such works are required to meet the requirements of this Specification and to be fit for the purposes intended.

The Services Contractor shall not drill through nor make any fixings to any structural steelwork, structural timber or reinforced concrete element of the building structure, without the prior written permission of the Structural Engineer.

G.9 INCOMING SERVICES & METERING

G.9.1 Gas and Water Services

The Contractor shall include the cost of all required incoming services within the Tender Sum.

The Contractor shall place orders for the required incoming gas and mains water services with the appropriate Supply Undertakings.

The Contractor shall supply and install pipe ducts as required by the supply companies.

The Contractor shall agree Gas and Water meter positions with the relevant Supply / Metering Companies.

No incoming service shall pass through the demise of any other property or tenancy area.

Water meters shall wherever possible be located in the pavement areas at the front of each building within appropriate pits with steel covers suitable for the location. In the case of flats/maisonettes the meters may be located in groups within pits with the use of standard manifolds as agreed with the Supply Company. The installation of the mains water up to the meter and the installation of the meter shall be carried out by the Water Supply Company. The installation of the water supply pipe from the meter and all the distribution pipework to and within the building shall be carried out by the Contractor.

Gas meters shall wherever possible be located within the demise of the building or tenancy area served. In the case of flats/maisonettes the meters may be grouped in a common Landlords Area subject to the agreement of the Supply Company. Gas meters shall be not be located under staircases and shall be installed within suitably ventilated and fire proof enclosures. The installation of the incoming supply up to the meter position shall be carried out by the Gas Service Network/Infrastructure Company. The installation of the gas meter shall be carried out by the nominated Gas Supplier. The installation of the gas supply pipe from the meter and all the distribution pipework to and within the building or tenancy area shall be carried out by the Contractor.

No gas or water service pipework either before or after the meter shall pass through the demise of any building or tenancy area other than the building or tenancy directly served by the supply.

In the case of flats/maisonettes incoming gas and water supplies and services pipes between meters and the residential units may be routed through purpose constructed vertical or horizontal common pipe ducts but these shall be wholly located within the demise of the Landlords Areas of the building. Ducts shall be fire resisting and shall be fire stopped at each entry point to a residential unit and between floors. Required access to common pipe ducts shall only be achieved from Landlords Areas. Ducts containing gas pipes shall be ventilated

Gas installations shall be in accordance with Gas Safe regulations.

G.9.2 Electricity Services

The Contractor shall include the complete cost of the required incoming services within the Tender Sum.

The Contractor shall place orders for the required incoming electricity services with the appropriate Supply Undertakings. The Contractor shall supply and install cable ducts, access chambers and draw wires as required by the supply companies.

The Contractor shall agree electricity meter positions with the relevant Supply / Metering Companies.

No incoming service shall pass through the demise of any building or tenancy area other than the building or tenancy directly served by the supply.

In the case of Residential installations, electricity meters shall generally be located within the demise of the residential unit served.

The installation of the incoming supply up to the meter position shall be undertaken by the relevant Network Company. The installation of the meter shall be carried out by the nominated Electricity Supply Company. The installation of the main supply cables from the meter and all the distribution within the residential unit shall be carried out by the Contractor.

Electrical services either before or after the meter shall not pass through the demise of any residential unit other than the unit directly served by the supply. In the case of flats/maisonettes incoming electricity services between meters and the residential units may be routed through purpose constructed cable ducts but these must be wholly located within the demise of the Landlords Areas of the building. Required access to such cable ducts may only be achieved from Landlords Areas.

Residential Electrical installations shall be in accordance with Building Regulations Approved Document Part P.
.

G.11 TESTING, BALANCING, COMMISSIONING & SETTING TO WORK

G.11.1 General

The Scope of the Works shall include the testing, balancing, commissioning and setting to work of all engineering systems installed under this Contract.

Testing, balancing and commissioning shall be undertaken by suitable specialists under the supervision of the Services Contractor.

The Services Contractor shall include in his Tender for all necessary specialist labour and equipment and facilities for access for the testing, balancing, commissioning and demonstration of the installations. The supply of all necessary tools, testing and recording equipment shall be included in the Tender. All test equipment shall have current certification to demonstrate calibration by BSRIA or other approved agency.

The Services Contractor shall notify the Main Contractor of all access required for balancing and commissioning works, so that specific ceiling tiles and access covers can be left unfixed until all such work is complete and the Services Consultant has accepted the balancing and commissioning works as satisfactory. Under no circumstances shall the Services Contractor attempt to remove or replace ceiling tiles.

The Services Contractor shall notify the Main Contractor of all access required for balancing and commissioning works, to enable specific ceiling tiles and access covers can be left unfixed until all such work is complete and the Services Consultant has accepted the balancing and commissioning works as satisfactory.

G.11.2 Notice of Tests & Commissioning Works

The Services Contractor shall give 7 day written notice to the Services Consultant of all proposed tests and commissioning works and the Services Consultant or his appointed representative will attend such tests as he considers necessary.

On completion of the testing, balancing and commissioning works or sections thereof, the Services Contractor shall present the results to the Services Consultant. The Services Consultant shall carry out any subsequent spot checks deemed necessary to confirm the commissioning results for which the Services Contractor shall provide all necessary attendance including trained personnel and equipment

as maybe required.

G.11.3 Connection to Existing Services

Where the Contract Works forms only part of the complete building engineering installation, (for example where the Contract Works forms a further phase or extension to an existing installation or where the Contract Works is a partial replacement of existing installations) and where specified, the Scope of the Commissioning Works shall include the existing services installations where these form part of the same engineering system as the Contract Works. This excludes Pressure Testing and Performance Testing of existing installations unless expressly stated.

In the case of electrical circuits this shall include any existing final circuit that is to be extended and the distribution panel or equipment item from which this emanates. Existing distribution panels and equipment shall be included where new circuits are extended from these.

In the case of heating and domestic water pipework systems, this shall include any existing circuit that is to be extended or modified. A circuit is defined as the complete network of pipework emanating from an item of central plant.

In the case of drainage pipes, this shall include the complete section of existing drain up to the final connection to the sewer heading (typically the last manhole). In the case of soil and waste pipework this shall include the complete section of soil and waste pipework up to the connection to the drain.

G.11.4 Sectional Testing

The Services Contractor shall allow in his Tender for the sectional testing of mechanical and electrical installations as required to meet the programme.

Where sectional testing is undertaken, the Services Contractor shall nevertheless carry out a complete retest of the entire system once the installation is complete.

G.11.5 Witnessing Tests

Once the Services Contractor has established that a system or part of a system is ready for testing, the Services Contractor shall proceed with the appropriate tests in accordance with the requirements below and in accordance with Health & Safety procedures.

Once the Services Contractor has established that the system or part of a system has passed the appropriate test, the Services Consultant shall be given reasonable notice to attend site to witness a re-test to verify and record results. The Services Consultant shall be at liberty to attend or to instruct the Main Contractor's Site Manger to witness the test.

On completion of the complete or sectional testing, balancing and commissioning works, the Services Contractor shall present the results to the Services Consultant and the Services Consultant shall carry out any further spot checks as deemed necessary and the Services Contractor shall provide all necessary attendance including trained personnel and equipment as maybe required.

The outcome of all tests including failed tests and the final re-test shall be recorded.

G.11.6 Concealed Services

Concealed or buried work shall be inspected and tested in the presence of the Services Consultant before any permanent covering is applied.

The Services Contractor shall give due notice in writing to the Services Consultant when concealed or buried work is ready for inspection and the Services Consultant shall, without unreasonable delay, carry out his inspection and/or witness the tests.

In no instance shall concealed or buried work be covered without previously having been tested by the Services Contractor in the manner described in the Specification.

G.11.7 Testing, Commissioning and Record Documentation Checklist

The Services Contractor shall employ the following checklist to confirm that all tests have been successfully completed and that the relevant certificates have been issued for inclusion in the Operating and Maintenance Manuals. The Checklist shall be edited and/or expanded to suit the scope of the Contract Works.

MECHANICAL SERVICES	Date of Draft Issue	Comments received from Services Consultant	Date of Final Issue	Any further Comments from Services Consultant	Date Accepted
Heating Pipework Pressure Test					
Chilled Water Pipework Pressure Test					
Domestic Water Pipework Pressure Test					
Gas Pipework Gas Safe Test/Purge Certificate					
Refrigerant Pipework Pressure Test					
Soil & Waste Pipework Pressure Test					
Drainage Pipework Pressure Test					
Condensate Pipework Test					
Boiler Commission					
Htg. Press Set/Expansion/Make-Up Commission					
HWS Heaters Commission					
Ventilation Plant Commission					
Central Aircon Plant Commission					
IT/Comms Room Aircon Commission					
Cold Water Booster Set Commission					

Heating Flow Rate/Balance					
Underfloor Htg Performance Certificate					
Underfloor Heating IR Photographs					
Zonal Heating/Cooling Performance Check					
Ventilation Airflow Rate/Balance					
Correct Fire Damper installation and operation					
Dom Water – Point of Use Temp Check					
Trace Heating Test/Commission					
Chlorination Certification					
Heating/Chilled Water Dosing					
Ductwork Leakage Tests					
Mech. Services Controls/BMS Commission					
Correct operation of all safety interlocks					
ELECTRICAL SERVICES	Date of Draft Issue	Comments received from Services Consultant	Date of Final Issue	Any further Comments from Services Consultant	Date Accepted
IEE/NICEIC Wiring Completion Certificate					
IEE/NICEIC Emergency Lighting Certificate					
Emergency Lighting Lux Level Certificate					
Fire Alarm, Design, Installation, and Test & Completion Certificates					
Fire Alarm Audibility Test					
Correct operation of all Fire Alarm interlocks					
Intruder Alarm Test Certificate					
Access Control Certificate					
Lighting Control/Dimming System Commission					
Lightning Protection Test Certificate					
TV/FM Installation Test Certificate					
Data Cabling – Cable Test Certificate					
Telephone/Broadband System Test/Commission					
Internal Lighting Lux Level Check					
External Lighting Lux Level Check					
Distribution Panel Schedules					
Correct operation of building/energy management systems					
Building Regulation Part P Compliance Certificate – applicable to Residential projects					

G.11.8 CIBSE Commissioning Codes

All Mechanical Services systems shall be pre-commissioned by the Services Contractor in accordance with the relevant CIBSE Commissioning Codes. All pre-commissioning checks shall be completed before any plant and equipment is put into operation. Where the Codes refer to recommended or preferred procedures, these shall be regarded as mandatory for the purposes of this Contract. All results shall be tabulated and issued to the Services Consultant.

The Services Contractor shall, after completion of all necessary pre-commissioning work, set to work and balance and regulate each of the Mechanical Services systems, strictly in accordance with relevant CIBSE Commissioning Codes. Where the Codes refer to recommended or preferred procedures, these shall be regarded as mandatory for the purposes of this Contract.

All specialist systems, including the following, shall be commissioned by the manufacturer, or approved specialist.

- Refrigeration Plant
- Packaged HVAC Plant
- Automatic Control Systems
- Water Treatment Plant
- Water Booster/Pressurisation Plant
- Heat Pump Systems
- Fire, Smoke and Gas Detection/Alarm Systems including associated cables
- Audio Visual Systems including associated cables
- Lighting Control/Management Systems
- Data/Voice Communication Systems

G.11.9 Pressure Testing Pipework Systems

All pressure testing shall be undertaken in strict accordance with Health and Safety Regulations and the HSE Guidance Note GS4.

Water Services:

On completion of the pipework installation or section thereof and before the application of any thermal insulation materials, the Services Contractor shall undertake a 3 stage pressure testing method.

The first stage shall be a pneumatic air test with applied pressure of 500mbar for 10 minutes. Any drop in pressure shall be investigated and repaired and the system re-tested. The procedure shall be repeated until the system passes this test.

The second stage test shall be a cold water pressure test with applied pressure of twice the working head maintained for a period of two hours. Any drop in pressure shall be investigated and repaired and the system re-tested. The procedure shall be repeated until the system passes this test.

Following successful cold test, the Services Contractor shall carry out a hot test on all heating and domestic hot water pipework. The hot test shall be conducted at the maximum design water temperatures (normally 80 deg C) and at the maximum design system pressures (normally 3 bar at the lowest point) utilising the system plant as the means of raising water temperature/pressure and circulation, and shall be maintained for a period of 24 hours. At the end of the test period the system shall be visually examined. Any signs of leakage shall be noted and appropriate steps shall be taken to undertake repairs after which exercise the system shall be retested. The process shall be repeated until no defect is apparent.

Gas Services:

The complete installation shall be pneumatically tested to a pressure of 150mbar applied for the duration of one hour. If any drop in pressure occurs, all joints shall be tested with soaped solution to determine the location of the leak. All leaking joints shall be remade and the system re-tested. This procedure shall be repeated until the system passes the test.

Equipment:

All plant and equipment connected to the pipework systems and subjected to system working pressures such as valves, radiators, boilers, cylinders, expansion vessels and heat exchangers shall be suitable for operating pressure of at least 150% of the actual working pressures. All such plant and equipment shall be pressure tested by the manufacturer at his works and the Services Contractor shall provide the Services Consultant with all manufacturer's pressure Test Certificates. Any faulty materials or workmanship noted during the specified tests shall be removed and subsequently rectified by the Services Contractor at his own expense, and a further test or tests made.

G.11.10 Pressure Testing Ductwork Systems

The Services Contractor shall provide test holes of 25mm dia. complete with approved airtight plugs in all ductwork systems at the locations and to the configurations as specified in the CIBSE Commissioning Codes and in the ductwork specification.

Where ductwork is to be insulated, the insulation shall be neatly trimmed around the test holes with an aluminium angle section to provide a stop and a separate section of rigid insulation shall be fixed in position over a test hole area. Labels shall be fixed to the insulation to identify test hole positions.

All ventilation ductwork shall be tested for air leakage strictly in accordance with the HVCA Specification DW/142 Part 2, and CIBSE code A.

All ductwork supplied under this contract is to be suitable for low velocity/pressure application unless expressly stated to the contrary.

G.11.11 Pipework Pressure Tappings, Orifice Plates, and Commissioning Stations

The Services Contractor shall provide and install self-sealing Binder tappings, orifice plates and commissioning stations in all pipework systems at the locations and to the configurations as recommended in the CIBSE Commissioning Codes and as specified elsewhere in this Specification and on the Design Drawings.

Flow measuring devices shall be provided on flow and return connections to all items of plant including pumps and on all connections to motorised modulating control valves.

Pressure Tappings shall in any case be provided at:

- Suction and delivery connections to all pumps
- Flow and return connections to all air heating and cooling coils, and items of plant
- Connections to orifice plates, and commissioning valves

Commissioning valves/sets/stations shall comprise a single unit complete with orifice plate, pressure tappings and flow regulation valve, which shall be installed in accordance with the manufacturers recommendations at the following locations:

- LPHW and Chilled water services to air coils
- Modulating control valve assemblies
- All main pipework and principal branch pipework

Double regulating valves shall be provided on return pipework in accordance with the CIBSE Commissioning Code recommendations to operate in conjunction with commissioning valve sets.

G.11.12 Underfloor Heating Commissioning

Where underfloor heating is by LPHW, a suitable flow measuring device fitted at the manifold shall be provided to record and regulate flow rate for each pipe loop circuit. The Services Contractor shall ensure each circuit is set to the correct flow rate and settings shall be recorded as part of the commissioning report.

The Services Contractor shall undertake an Infra-Red camera survey of every room heated by underfloor heating including electric underfloor systems to provide a clear map of any under-heated areas of floor. The heating in each room shall be turned to maximum and the complete floor within the room photographed using IR technology. The results shall be tabulated on a room by room basis and issued the Services Consultant for consideration.

G.11.13 Ductwork Systems Balancing and Commissioning

The Services Contractor shall provide in all ductwork systems, test holes complete with air-tight plugs, as necessary to fully commission each system in accordance with CIBSE Commissioning Codes.

G.11.14 Electrical Tests

The Services Contractor shall undertake all tests to low voltage (230v single phase/400v 3 phase) and extra low voltage installations as required by the BS 7671 and shall provide a Completion Certificate with respect to all electrical services installations which form part of this Contract. This shall include electrical services associated with the Mechanical Services Installations, the Lift Installations and all other specialist services installed under the Contract such as Entry Phone and Motorised Blinds/Windows/Gates/Doors.

The Services Contractor shall engage a suitably qualified electrical test engineer to conduct a full 'Live' test of the Low Voltage and ELV electrical services installations to BS 7671 under operating conditions with the permanent incoming electrical supply connected to the system. Data, Signal, and Alarm cables shall be tested by a suitable specialist to confirm performance.

All Electrical services cable installations including ELV services shall be dead tested at the earliest opportunity and prior to connection to operating voltages. LV cables shall be subjected to continuity, resistance and insulation tests as BS 7671. ELV, data and signal cables shall be 'bell' tested for continuity. Any cables failing tests shall be replaced. All results shall be tabulated and issued to the Services Consultant.

All cables installed under the Contract in connection with specialist installations such as Fire Alarm, Intruder Alarm, CCTV systems, Access Control, TV/FM/Digital Antenna/Satellite Dishes and Entertainment/TV/Hifi systems shall be tested by the relevant specialist installer to establish that cables are fault free and a complete schedule of cable test result shall be provided.

All telephone and data cabling installed under the Contract, whether or not cable termination is part of the Contract Works, shall be tested by the Services Contractor to establish that all cables are fault free. A complete schedule of cable test result shall be provided.

G.11.15 Test Certificates

The Services Contractor shall provide detailed Test Certificates for all witness tests which shall record the system or part of the system tested, the day/time of the test, those present, the system design pressure, the system test pressure, the duration of the test and the outcome. Test Certificates shall be provided for the complete pipework and ventilation systems and shall be included within the Operation and Maintenance Manuals as described elsewhere.

G.11.16 Presentation of Test and Commissioning Results for Approval

All tests and commissioning work shall be fully documented by the Services Contractor for consideration and approval by the Services Consultant.

The results of electrical tests shall be presented in the form of NICEIC/IEE Completion Certificates, specialist Completion Certificates, Cable Testing Schedules and Distribution Panel Schedules with Schematic Drawings to confirm the relationship of Incoming Supply, Metering, Main and Sub-Panels and Main and Sub-Main Cables.

The results of pipework and ductwork balancing tests shall be presented in the form of Schedules tabulating both the measured and design values of grille/diffuser air volumes and commissioning/measuring valve flow rates and Schematic diagrams of all ductwork and pipework systems showing the relationship of plant, distribution network and terminal devices which shall be cross referenced to the Schedules.

All test and commissioning certificates shall be completed with full details of the testing/commissioning company and shall be signed and dated.

G.11.17 Performance Tests

On completion of all commissioning works, the Services Contractor shall allow for carrying out a full two day's Performance Test in the presence of the Services Consultant, to ascertain that the whole of the services installation is in working order and is operating in accordance with the Performance Specification.

The Services Consultant shall specify when the tests shall be carried out and the test days may or may not be consecutive, but tests will be carried out within the 12 month Defects Liability Period.

Tests shall be carried out over a 24 hour day and the Services Contractor shall allow for the supply and placing in positions as required by the Services Consultant, of up to three thermo thermo-hygrograph recording instruments throughout the duration of the tests to record temperature conditions within the building.

The Services Contractor shall also provide and position one external thermo-hygrograph to record external temperature and humidity conditions.
The Services Contractor shall also record the following information for each day the tests are run:

- Time heating/cooling/ventilation plant started up and shut down
- Boiler primary LPHW flow and return temperatures recorded every hour
- Compensated heating flow and return temperatures recorded every hour
- Chilled water flow and return temperatures recorded every hour
- Recordings from 1 No. external thermo-hygrographs for two-day period
- Recordings from 3 No. thermo-hygrographs for two-day period to cover a maximum of 6 zones. Services Consultant to decide location of zones

G.12 RECORD INFORMATION

G.12.1 Record Drawings

The Services Contractor shall provide at the time of Practical Completion, Record Drawings of the complete installation showing positions of all services and equipment installed under the Sub-Contract.

The Record Drawings shall be submitted in the form of three prints on paper of each Record Drawing plus two copies on CDROM discs saved in PDF format (Adobe Software).

Prior to the final issue, Record Drawings shall be submitted to the Services Consultant for comment and approval.

Floor plans shall be to the scale of 1:50. Larger scale drawings shall be prepared by the Services Contractor when deemed necessary and instructed by the Services Consultant.

The Services Contractor shall provide schematic drawings of all pipework and ductwork systems. Schematics of domestic hot and cold water systems and cooling tower systems shall be in a format to accord with the requirements of ACOP L8.

The Services Contractor shall provide schematic wiring diagrams of all control panels and all field controls wiring.

The Record Drawings shall indicate the set position of each regulating valve after the completion of balancing, together with each valve number to correspond with the Valve Chart.

The Services Contractor shall provide schematic wiring diagrams for all lighting and small power elements, drawings shall also indicate primary cable tray and trunking routes.

The Services Contractors shall provide a distribution schematic indicating all HV & LV cables, isolation devices and distribution boards.

The Services Contractor shall provide distribution board schedules for all distribution boards and panel boards.

G.12.2 Test and Commissioning Certificates/Reports

Test Reports shall include Manufacturer's Test Certificates, Specialist Commissioning Reports, Underfloor Heating IR Photographs, Pipework Pressure Test Results, Ductwork Leakage Test Results, Chlorination Certificate, BS 7671 Electrical Test Results and copy of the Completion Certificate, and Completion and Test Certificates for the Fire Alarm, Emergency Escape Lighting and Lightning Protection Installations, complete records of the Services Contractor's Commissioning Works, and Records of the Performance Tests, all as detailed elsewhere in this Specification.

The Services Contractor shall collect together two sets of all signed and approved Test Reports and assemble and index these either within dedicated hard cover binders or as part of the Operating & Maintenance Manuals. One set of these documents must be original versions of the test and commissioning certificates; the other set may be either original versions or high quality colour photocopies.

G.12.3 Mechanical & Electrical Record Manuals

The Services Contractor shall employ a suitable specialist to compile the Record Manuals. This specialist shall be named within the Services Contractor's Tender submission.

The Record Manuals comprise the Building Log Book and the Operating & Maintenance Manuals which shall include the Record Drawings. These manuals may be combined into one or more indexed volumes as appropriate for the project size and complexity.

At least 6 weeks before programmed Practical Completion of the Works, the Contactor shall issue substantially complete (test certificates excepted) Record Manuals in draft hard copy form for the comments and approval of the Architect, CDM Coordinator and Services Consultant who shall be given 10 working days to comment. The Services Contractor shall amend/complete the Record Manuals and re-issue for final approval of the Architect, CDM Coordinator and Services Consultant who shall be given further 5 working days to confirm approval or advise any need for further amendment. This process shall continue until unqualified approval status of the Record Manuals is confirmed by the Architect.

Two copies of each Approved Record Manual shall be provided in 'hard copy' format and two copies shall be provided as electronic versions saved to CDROM disks.

The Record Manuals are provided for the retention and exclusive use by the building owner/user and shall be kept on Site in a position agreed with the building owner and users/occupiers.

All information and literature provided in the manuals shall be clearly presented, legible, job specific, and the manuals shall contain no information or literature that is not relevant to this project.

The hard copy Record Manuals shall be enclosed within folders with hard covers labelled for this project.

The manual binding system shall be of good quality 4 hole A4 size locking ring binder type and shall not be overfilled. Where necessary additional volumes shall be provided as necessary to ensure the manuals are easy and convenient to use.

All pages shall be numbered and referenced. Each section shall have a detailed index with sectional page numbers/references.

The electronic versions of the Record Manual shall be in the same format and arrangement as the hard copy manuals and shall be formatted as "Read Only" PDF (Adobe Software) versions saved to CDROM disk(s). CDROM disks shall be labelled with project information, date and version/revision.

The electronic version shall be compiled using Adobe compatible indexing/navigation software (such as Autobook by Evermap) to provide Indexing using a hierarchy of "bookmarks" to identify Sections and Sub-Sections. In addition "links" shall be placed into the text to enable automatic jump to definitions and other related sections, and a word search system shall be provided using "text highlighting" to enable easy and fast navigation of the document. Each CDROM disk shall include suitable licence-free 3rd Party Abobe Read Only software. The Services Contractor shall include any costs that may arise in the purchase of software licences for 3rd party users of these documents.

G.12.4 Valve Charts

On completion of the Contract, the Services Contractor shall provide one Valve Chart for mounting inside each principle plant room, framed under glass or transparent plastic, as directed by the Services Consultant. Two additional copies are to be handed to the Services Consultant and a copy of each diagram shall be incorporated into the Operating & Maintenance manual.

The valve charts shall take the form of a system schematic showing each pipework system with each valve appropriately numbered its function and size clearly defined and its normal operating position indicated.

G.12.5 Single Line Distribution Diagrams

On completion of the installation, the Services Contractor shall provide single line distribution diagrams for mounting within plant and equipment room. Each diagram shall be framed under glass or transparent plastic, or as directed by the Services Consultant. Two additional copies are to be handed to the Services Consultant and a copy of each diagram shall be incorporated into the Operating & Maintenance manual.

Single Line Distribution Diagrams shall be provided for each of the following:

Gas Distribution
Mains Water Distribution
Electrical Mains and Sub-Mains Distribution
Fire Alarm Installation

G.12.6 Identification of Services

The Services Contractor shall identify all mechanical services in accordance with BS 1710 and the CIBSE Guide to current practice. Each pipe service shall be provided with colour band, flow direction arrows and service reference letters.

The pipework service reference lettering shall be in accordance with the 1970 IHVE Guide section C10 "Standard Symbols and Notations".

Ventilation ductwork service shall be identified by direction flow arrows and service reference lettering to describe briefly the service, i.e. Toilet S, Toilet E, etc.

All of the gas pipework within the building shall be painted one coat of Yellow Ochre to BS 4800-08 C 35.

The Services Contractor shall identify all main and sub-main cables by means of engraved or embossed trays fixed at 10 m centres and at each change of direction.

G.12.7 Labels

The Services Contractor shall supply and fix ivorine or similar approved labels to all items of equipment such as valves, switches, controls, distribution/fuse boards, pumps and other plant items etc., which form part of his works and these labels shall bear such identifying information as is considered necessary by the Services Consultant.

All principal valves shall be provided with identification discs security non-ferrous or plated chain indicating valve reference number, which shall be cross-referenced to the Valve Chart.

All distribution boards shall be provided with internal labels to clearly identify all outgoing circuits and within each board the Services Contractor shall provide a detailed schedule printed on plastic film with a full description of each outgoing circuit giving fuse/mcb rating and cable size.

G.12.8 Name Plates

All plant and equipment supplied under this Contract shall be fitted with a plate located in an accessible position. Upon this plate, which shall be of non-ferrous material and fixed by setscrews, shall be engraved the Manufacturer's name, date of manufacture and other important particulars of the plant or equipment.

G.12.9 Building Log Book

Not Applicable

G.12.10 Operating & Maintenance Manual

For all buildings the Services Contractor shall provide at the time of Practical Completion of the Works three sets of Operating and Maintenance Instructions. Where the Services Contractor is required to provide a Building Log Book, the Operating and Maintenance Instructions shall be incorporated into the Building Log Book. Where there is no requirement for a Building Log Book, the Operating and Maintenance Instructions shall be provided in the form of a stand-alone Manual or Manuals.

The manual shall be sectionalised as follows. The following contents schedule is not intended to be exhaustive and the Services Contractor shall include additional information where this is clearly necessary for the safe and reliable operation and maintenance of the mechanical and electrical services.

<u>Section 1- The Introduction</u>

1.1 Contents of Manual
1.2 Purpose of Manual
1.3 Emergency Contact Details for Gas, Electricity and Water Supply Companies
1.4 Contact Details for Maintenance Contractors including 24 Hour Call-Out Hotlines
1.4 Names and Addresses of Design and Contract Organisations
1.5 General Description of each Engineering Service
1.7 Definitions and Explanations of Technical Abbreviations, Terms and Words used in the Manual

<u>Section 2 - The Services Installations</u>

2.1 Detailed Description of Installation on a service-by-service basis.
2.2 Location and Details of Incoming Service Metering
2.3 Location of Main Gas and Water Isolating Valves and Main Electrical Isolators
2.4 Design Information - basis of design and design criteria

Section 3 - Operating Procedures

3.1 The Operation of each system
3.2 How to Turn On and Turn Off each system
3.3 How to set and change Time Switches and Thermostat Settings
3.4 Use of Master Controls
3.5 Efficient Use of Energy – Procedures to minimise Running Costs
3.6 Alarms – Where located and What to do in event of Alarms activated (each alarm to be covered)
3.7 Fault tracing and diagnosis guidance provided in Flow Chart format
3.8 Emergency Procedures in event of system failure or malfunction
3.9 Electricity Supply Failure – What to do in event of Electricity Supply Failure
3.10 Gas Supply Failure – What to do in event of Gas Supply Failure
3.11 Water Supply Failure – What to do in event of Water Supply Failure
3.12 Periods of Un-occupation – What to do if building is to be un-occupied for a period of time
3.13 Extreme Weather – What to do in event of risk of floods and storms and severe cold weather.

Section 4M - Associated Electrical and Control Systems (Mechanical Services)

4M.1 Full description of the installation
4M.2 Operation of the various control systems for each system
4M.3 Control Panel Wiring Diagrams and Field Wiring Diagrams
4M.4 Control Manufacturers' equipment literature

Section 4E - Electrical Supply Characteristics (Electrical Services)

4E.1 Location drawing of Incoming Supply, Cut-Out Fuses, Meters and Main Distribution Panel
4E.2 Network Company and Supplier/Metering Company with contact details, emergency telephone numbers and supply references
4E.3 Schedule of incoming electricity supply characteristics including voltage and capacity of incomer, incomer cable size and type, prospective earth loop impedance, prospective fault current, earthing system, and cut out fuse rating

Section 5 - Plant & Equipment

5.1 Schedule of manufacturers and suppliers with names, addresses, and contact details
5.2 Schedule of plant and equipment manufacturer, duties, type, reference and serial numbers
5.3 Schedule of manufacturers spares and accessories with reference numbers.
5.4 Electronic Asset Register scheduling all plant and equipment with installation dates to be completed by Services Contractor using free-issue Client/Employers database

Section 6 - Maintenance Procedures

6.1 Maintenance of Users on-site Maintenance Logbook. Sample pages to be provided
6.2 Planned Preventative Maintenance Programme
6.3 Preventative Maintenance Schedules to include procedures and frequency for the routine maintenance of all plant, equipment and systems

Section 7 - Manufacturers Literature

7.1 Manufacturers literature. The information provided will generally be copies of the manufacturer's catalogue information and shall provide details of correct installation and maintenance procedures. Photocopies shall be of high quality and colour copies shall be provided where required for clarity. No literature shall be included if not relevant to this installation

Section 8 - Health & Safety

8.1 Safety procedures to be adopted in accordance with Health and Safety Executive Guide Lines and measures to be taken in the event of fire, explosion, evacuation, and other emergency situations.
8.2 First Aid procedures
8.3 Measures to prevent risk of Legionnaires Disease.
8.4 Advice on the avoidance of use of deleterious materials.

Section 9 - Test & Commissioning Certificates & Records

9.1 Copies of the Test & Commissioning Certificates and Records - One manual to contain original versions of certificates

Section 10 - Record Drawings

10.1 One set of the Services Record Drawings per Manual.

G.12.11 Abbreviated Operating & Maintenance Manual (Residential Properties)

In additional to the requirements of G.12.10 which shall apply to each building, where the project includes the construction or refurbishment of one or more residential units, the Services Contractor shall provide at the time of Practical Completion of the Works two sets of Abbreviated Operating and Maintenance Instructions for each residential unit. One set shall be retained by the occupant and the other set shall be retained by the developer/landlord/managing agent as appropriate; owner occupiers shall be provided with both sets of documentation.

The Abbreviated Operating and Maintenance Manual shall be in accordance with the requirements of Specification Clause G.12.3.3 except that CDROM version shall not be required.

The manual shall be sectionalised as follows:

Section 1- The Introduction

1.1 Contents of Manual
1.2 Purpose of Manual
1.3 Emergency Contact Details for Gas, Electricity and Water Supply Companies
1.4 Contact Details for Maintenance Contractors including 24 Hour Call-Out Hotlines
1.4 Names and Addresses of Design and Contract Organisations
1.5 General Description of each Engineering Service
1.7 Definitions and Explanations of Technical Abbreviations, Terms and Words used in the Manual

Section 2 - The Services Installations

2.1 Detailed Description of Installation on a service-by-service basis.
2.2 Location and Details of Incoming Service Metering
2.3 Location of Main gas and Water Isolating Valves and Main Electrical Isolators

Section 3 - Operating Procedures

3.1 The Operation of each system
3.2 How to Turn On and Turn Off each system
3.3 How to set and change Time Switches and Thermostat Settings
3.4 Use of Master Controls
3.5 Efficient Use of Energy – Procedures to minimise Running Costs
3.6 Alarms – Where located and Action to be taken in event of Alarm activation (each alarm to be covered)
3.7 Fault tracing and diagnosis guidance provided in Flow Chart format
3.8 Emergency Procedures in event of system failure or malfunction
3.9 Electricity Supply Failure – What to do in event of Electricity Supply Failure
3.10 Gas Supply Failure – What to do in event of Gas Supply Failure
3.11 Water Supply Failure – What to do in event of Water Supply Failure
3.12 Periods of Un-occupation – What to do if building is to be un-occupied for a period of time
3.13 Extreme Weather – What to do in event of risk of floods and storms and severe cold weather.

Section 4 - Plant & Equipment

4.1 Schedule of manufacturers and suppliers with names, addresses, and contact details

Section 5 - Maintenance Procedures

5.1 Planned Preventative Maintenance Programme

Section 6 - Health & Safety

6.1 Safety procedures to be adopted in accordance with Health and Safety Executive Guide Lines and measures to be taken in the event of fire, explosion, evacuation, and other emergency situations.
6.2 First Aid procedures
6.3 Measures to prevent risk of Legionnaires Disease.
6.4 Advice on the avoidance of use of deleterious materials.

Section 7 - Efficient Use of the Building and Energy Management (Sustainable Homes Guidance)

7.1 Full record information necessary to meet the requirements of Sustainable Homes Code 4 MAN 1 – Home User Guide as detailed in Section B.8.9 of this Specification. In particular this is to include the following sections – Environmental Strategy/Design and Features, Energy, Water Use, Recycling and Waste, Sustainable DIY and Emergency Information (e.g. Fire Alarm).

G.13 MAINTENANCE

The Services Contractor shall provide an optional cost outside of the Tender Price for the maintenance of the complete building services installation from the time of Practical Completion until the end of the 12 months Warranty Period.

The Maintenance Agreement shall be a direct contract between the Services Contractor and the Employer.

The maintenance work shall be undertaken by suitably qualified and experienced operatives. If appropriate the Services Contractor shall engage a specialist Maintenance Contractor.

All work associated with electrical installations within Residential and Domestic Buildings shall be undertaken by Part P Certified electricians.

All work associated with gas installations shall be undertaken by registered Gas Safe engineers.

The Services Contractor shall make a minimum of two services visits per year. More frequent maintenance visits shall be provided where recommended by the relevant equipment supplier such as ventilation plant. Maintenance does not include routine replenishment of chemicals and other consumable items required for the operation of equipment such as water softeners.

The Services Contractor shall make arrangements with the Owner/Occupier as appropriate to agree in advance when service visits are to be carried out.

The maintenance is to include all necessary servicing and routine attention to all elements of the installations in accordance with the relevant manufacturers' or suppliers' recommendations and is to include the cost of labour, materials and transport necessary to undertake these works.

Maintenance of the Fixed Electrical Installation, the Fire Alarm System, the Emergency Lighting Installation, and the Intruder Alarm System shall be undertaken in strict compliance with relevant British/European Standards, Building Regulations and relevant accreditation/regulation organisations including IEE, NICEIC, BRE, LPCB, BAFE, and NACOSS. Maintenance shall include once only annual electrical PAT testing of all loose electrical items of equipment installed under the original Contract such as table lamps, kitchen and laundry equipment.

Maintenance of domestic water services shall include attention to the requirements of ACOP L8 Regulations concerning control of Legionella and other water borne organic contaminants.

On completion of each service visit, the Maintenance Contractor shall complete a service record which shall schedule all the work carried out and any repairs and replacement materials used.

The Services Contractor shall provide a 24 hour call-out service to repair faults and system failures. The cost of any call-out shall be borne by the Services Contractor if the cause of the failure is due to either poor maintenance or Services Contractors liability.

The Services Contractor shall guarantee a response to any call-out request as follows:

a) Where the Client states the call-out is an emergency: the Services Contractor shall attend site with appropriate operatives within 24 hours.

b) Where the Client states that the call-out is not an emergency: the Services Contractor shall attend site with appropriate operatives within 48 hours

If a permanent repair is not possible at the time of the initial call out, the Services Contractor shall ensure that temporary measures are taken to ensure the installation is left safe and that the Client is subjected to the minimum possible inconvenience due to loss of service and that a follow-up attendance to effect permanent repair is organised with minimum possible delay.

SECTION PERFORMANCE SPECIFICATION FOR CONTROL SYSTEMS, CONTROL PANELS AND ASSOCIATED WIRING WORKS

H.1 GENERAL

Section H of the Specification is a Performance Specification.

The provision of the Automatic Controls Systems shall be undertaken by a suitable approved Controls Specialist employed as a domestic sub-contractor to the Services Contractor.

In this Section H of the Specification the term “Services Contractor” shall mean the Services Contractor and shall include the Controls Specialist or other approved specialist installer employed by the Services Contractor.

The Services Contractor shall be responsible for meeting the performance requirements as set out in Section H. The Services Contractor shall include for the design, supply and installation of all necessary services and equipment to achieve these requirements.

The Service Contractor shall design, install, test and commission automatic controls systems as described hereunder and as indicated on the Tender Drawings. Any discrepancy between Specification and Drawings shall be brought to the attention of the Services Consultant by the Services Contractor prior to installation.

Automatic controls systems shall mean the complete control systems required to provide the automatic control and safe management of the mechanical services systems by whether electrical, electronic, pneumatic, and direct acting means including all associated thermostats and sensors, motors and actuators, flow and pressure control devices, electronic controllers, timers and programmers, electro-pneumatic devices, electrical contactors and motor starters, associated wiring, and control and motor starter panels.

The control panels and the controls equipment shall be supplied, installed and commissioned under this Sub-Contract by the Controls Specialist.

The Controls Specialist shall fix in position wall mounted thermostats and temperature sensors, and valve and damper actuators specified under this section.

Pipeline and cylinder thermostats and sensors, pipeline control valve bodies, air duct thermostats and sensors, and air flow and water level switches shall be fixed in position by the Services Contractor as part of the installation of pipework, ductwork and plant.

Electrical Wiring Works associated with the Mechanical Services Installation shall be included within this Sub Contract and shall be undertaken by the Controls Specialist or other approved specialist installer as specified under H2 of this Specification.

The Services Contractor shall undertake full commissioning of the control systems within the Contract programme in accordance with CIBSE Code C:2001 and shall also undertake a complete commissioning check 6 months after hand-over, or at a suitable time within the defects liability period to be agreed by the Services Consultant.

The Services Contractor shall provide a full report of the results of the commissioning exercises including all set points and any adjustments made to meet the design requirements.

H.2 ASSOCIATED ELECTRICAL SERVICES

H.2.1 General

For all Residential Applications, the mains voltage and signal/control wiring shall be installed in accordance with the relevant manufacturers’ requirements and in accordance with BS 7671. Wiring shall be concealed from view and recessed in conduit in all visible locations other than boiler/service cupboards and service voids where surface installation within conduit or trunking is permitted. In ceiling and floor voids cables do not require containment unless required under BS 7671.

All electrical installation works including power supplies to motors and electric heaters, control wiring to items of plant and controls equipment and signal wiring associated with electronic instrumentation and data gathering systems shall be installed under this Sub-Contract.

All work shall be carried out strictly in accordance with BS 7671 (IEE Wiring Regulations). Where the installation is within, or is part of, a residential property, all operatives engaged on the installation of electrical services shall be suitably qualified and registered as required under Part P of the Building Regulations. All electrical installation works required in connection with the installation of Mechanical Services plant, equipment, services and controls systems shall only be undertaken, supervised and tested by NICEIC registered operatives.

The Services Contractor shall be responsible for the prompt issue to the Services Consultant of all information concerning motor kW, starting current, voltage and operating current and wiring diagrams. The information shall be obtained as soon as possible after the Contract has been awarded. The information shall be supplied in a schedule, which shall be updated as necessary during the Contract by the Services Contractor.

The Services Contractor shall mark out on site, in conjunction with other Electrical Contractors the position of all his electrical controls and equipment for the agreement of the Main Contractor and Architect.

On completion the electrical works the installer shall test and installation in accordance with BS 7671 and shall issue a Completion Certificate for the Design and Installation in accordance with BS 7671.

H.2.2 Scope of Work

It shall be the responsibility of Controls Specialists responsibility to specify all cables and to determine and detail all cable routes throughout the building and to external positions where required.

The Mechanical Services Builders Work and Installation Drawings shall include all such information, which shall be fully co-ordinated with the structure and with the routings of other services by the Services Contractor.

The Controls Specialist shall, as part of this Sub-contract install necessary electrical wiring required to connect between:

- Control Panels and Controls Equipment
- Control Panels and Equipment Control Panels for back indication and local control.

The controls specialist shall also provide the wiring connections between the isolator left by the Electrical Contractor and each of the Control Panels. The isolator shall be located within 3m of each control panel.

The Controls Specialist shall also undertake to provide the wiring connections between the isolator left by the Electrical Contractor and each item of plant, which is specified as requiring a local electrical supply.

The Services Contractor shall include for the following cable installations:
All Control/Monitoring wiring required to and from Control Panels
All Control/Monitoring wiring required to and from sensors/thermostats and pressure differential switches
All Control/Monitoring wiring required to and from valves and actuators
All Control/Monitoring wiring required to and from user controls including aircon, heating and ventilation controls
All 230/400V mains wiring required between local isolators (provided under Electrical Installation) and control panels
All 230/400V mains wiring required between local isolators (provided under Electrical Installation) and aircon units, fan coil units, fan convectors, underfloor/trace heating, towel/panel heaters and water heaters etc requiring an electrical supply
All 230/400V mains wiring required between Control Panels and items of Mechanical Services Plant such as pumps, ventilation equipment, pressurisation/booster sets, chillers/condensers, water treatment equipment and water heaters except where such plant/equipment item is expressly specified as having a direct electrical supply taken from the Electrical Installation.

Where local ventilation fans are specified as being wired from the local lighting circuit, all wiring associated with this shall be undertaken as part of the Electrical Installation.

H.2.3 Cables

Cables shall be enclosed in conduit, trunking and within short lengths of flexible conduit for final connections to the various items of equipment.

All cables shall be of the PVC insulated type to the details specified below. All cables shall be LSF rated except only in the case where such rating is not commercially available.

Should cables of any other specification be required, the prior written approval of the Services Consultant shall be obtained.

Care shall be taken during installation to avoid scuffing of the cable sheathing and installation shall be carried out to manufacturer's recommendations.

Armoured and un-armoured control and instrumentation cables for ELV application shall be control and instrumentation rated at 60V core to earth or 120V core to core. Construction shall generally be plain copper conductors, polyethylene or XLPE insulated, bonded aluminium tape screens where required, compound bedded, single wire armoured and sheathed. Armouring and bedding may be omitted if not required. Specification shall be BS EN 50288.

Cables for drawing through conduit shall be single core multi-stranded wiring cables rated at 450/750 volts from 2.5mm^2 to 16mm^2 for drawing through conduit. Construction shall be stranded plain annealed copper conductor (note: stranded conductor to be used at 2.5mm^2 and above). Cross-linked insulation or EPR insulation covered with over-sheath. Specification shall be BS 6004, reference 6491X or 6181Y.

Insulated and sheathed wiring cables shall be non-armoured multi-core non-flexible wiring cables rated at 300/500 volts from 2.5mm^2 to 16mm^2. This type of cable may only be used if enclosed in conduit or trunking. Construction shall be annealed copper conductor, compound or EPR insulation compound over-sheath. Specification shall be BS 6004.

Panel wiring cables shall be single core electric cables rated at 600 volts for panel wiring. Construction shall be stranded plain annealed copper conductor (note: stranded conductor to be used at 2.5mm^2 as well as larger sizes). Cross-linked insulation or EPR insulation covered with over-sheath. Specification shall be BS 6004, reference 6491X or 6181Y.

Fire survival cables for power, control, and emergency lighting required to maintain circuit integrity in the event of a fire. Cables for Fire Alarm applications shall be as specified elsewhere. Construction shall be either:

- Mineral insulated copper conductor cable to BS EN 60702 for use on power, control and alarm application
- Silicon rubber insulated, aluminium/poly laminate and composite sheath with tinned copper earth continuity conductor

Control and signal cables and services operating at ELV potential shall be segregated from mains voltage cables. In field wiring situations a minimum clearance of 300mm shall be provided between control/signal cables and mains voltage cables where these are routed parallel to each other.

H.2.4 Conduits and Conduit Accessories

Conduits and conduit accessories shall be as detailed in Section E of the Specification.

All wiring within plant rooms with the exception of armoured cables and ELV cables shall be contained within either conduit or trunking. All external wiring except armoured cables shall be contained in conduit. Galvanized conduit shall be used in Plant rooms, externally and in all wet/humid areas.

Other than plant rooms and external locations, all cables shall be either installed within conduit or trunking containment or clipped to cable tray.

ELV and signal/data cables shall be kept separate from low voltage cables. Separate trays, trunking and conduits must be used. Under no circumstances shall signal/data cable be routed parallel to LV cables unless separated by at least 300mm.

Cable drops in walls shall be run in high impact PVC round or oval conduit.

H.2.5 Surface Cable Trunking

Surface cable trunking shall be as fabricated and installed as detailed in Section E of this Specification.

All wiring within plant rooms with the exception of armoured cables and ELV cables shall be contained within either conduit or trunking.

Other than plant rooms and external locations, all cables shall be either installed within conduit or trunking containment or clipped to cable tray.

ELV and signal/data cables shall be kept separate from low voltage cables. Separate trays, trunking and conduits must be used. Under no circumstances shall signal/data cable be routed parallel to LV cables unless separated by at least 300mm.

H.2.6 Flexible Conduit

Conduit connections to motors or other such items of removable equipment and where flexibility is required in the installation, unless otherwise stated, shall be made with galvanized metallic flexible conduit, in accordance with Class 4 BS EN 61386.

Each end of the flexible conduit shall be terminated by a coupler comprising a union, lead seal and screwed nut. Each coupler shall have a made thread for connecting to a standard BS EN 61386 box or an equipment terminal box.

Flexible conduits shall not be less than 300mm and more than 1.0m in length unless permitted in writing by the Services Consultant.

H.2.7 Cable Tray

Cable tray shall be fabricated and installed as detailed in Section E of this Specification.

In all areas armoured cables shall be clipped to cable tray.

Other than plant rooms and external locations, all cables shall be either installed within conduit or trunking containment or clipped to cable tray.

ELV and signal/data cables shall be kept separate from low voltage cables. Separate trays, trunking and conduits must be used. Under no circumstances shall signal/data cable be routed parallel to LV cables unless separated by at least 300mm.

H.2.8 Protection and Painting

Suitable protection of electrical and controls equipment shall be provided as required by location. All equipment shall be suitably IP rated for the application and in accordance with BS 7671. All fixings shall be appropriate for location.

Where there is no alternative to locating equipment in a vulnerable position and there is a risk of mechanical damage the equipment shall be housed within a suitable protective enclosure.

All electrical equipment shall be supplied and installed with the manufacturers paint finish intact. Any damage to the paint finish will require replacement of the item.

The Services Contractor shall apply decorative paint finish to conduit and trunking as specified.

H.2.9 Labels

All equipment and electrical accessories shall be fitted with external labels made from rectangular pieces of approved Ivorine, Perspex or laminate. The characters shall be engraved, coloured black against a white background, complete with beveled edges and fixed by means of chrome screws, nuts and washers.

Lettering shall be no less than 6mm high with larger letter for main equipment such as panels.

All details shall be submitted to the Services Consultant for approval.

H.2.10 Motor Starting

Motors of rating 1.5 kW and over shall be suitable for 400v 3 phase electrical supply unless specified otherwise.

Unless specified to the contrary the following motor starting arrangements shall be employed:

Up to 1.5 kW	Direct on Line
Over 1.5 kW	Inverter Soft Start

All motors and drives shall be suitable for the above starting arrangements.

H.2.11 Electrical Bonding

The services shall be effectively earth bonded in accordance with BS 7671.

The Services Contractor shall electrical bond the mechanical services as detailed in this specification and in accordance with BS 7671.

Bonding of metallic duct and pipework cladding shall be made with 4mm^2 stranded copper cable (colour coded green/yellow) fixed to the cladding earth tags or studs by ring space terminal lugs compressed onto each end of the bonding cable. The bolt or stud fastening to the cladding shall be 8mm diameter. An approved inhibitor shall be applied between the clamping surfaces of the lug and cladding.
Where a motorised valve or other electrical apparatus is fitted onto a metal clad duct or pipe run, lugs or studs shall be provided on the clad surfaces each side of the apparatus and bonded across made in 4mm^2 cable. The bolt or stud size shall be 8mm diameter.

On unclad duct and pipe runs, bonds across flexible joints and any other point of discontinuity shall also be made in 4mm^2 cable with lugs each end. The lugs shall be sized to the cable not to a flanged fixing bolt. Connection to the pipe or duct shall be made by an earth lug fitted under the flange fixing bolt or where appropriate by a drilled and tapped hole into one flange fixing bolt.

The bonding shall be located on the top of clad services.

The final earth bonding of the mechanical services at the point of origin will be by others.

H.2.12 Local Isolators

The Services Contractor shall supply and fix adjacent to each item of plant, which receives an electrical power supply originating from one of the control panels provided under this Sub Contract, a suitable electrical isolator.

Local isolators shall isolate line voltage and neutral and shall be 4 pole in the case of TPN supply and 2 pole in the case of SPN supply. Stop-lock buttons or other devices which interrupt only the motor control circuit shall not be employed unless a suitable local isolator is also provided.

The isolator shall be clearly visible to any operative working on the respective item of plant and shall in any case not be more than 2.0m from the electrical connection to the plant.

Isolators shall be clearly labelled to indicate which particular item of plant it serves.

Isolators shall be positioned such that the electrical connection between isolator and plant can be carried out in flexible conduit.

H.2.14 Exclusions

The following works are excluded from this Sub-Contract and shall be carried out under the Electrical Services Contract:

- Lighting and small power services within plant rooms and service shafts and voids
- Electrical power supply to isolators located adjacent to both Mechanical Services Control Panels and to items of plant where these are specified as having a local electrical supply by Others.

H.4 CONTROLS SYSTEM OPERATION – RESIDENTIAL APPLICATION

H.4.1 General

H.4 provides a reduced and simplified specification for use on large Residential projects and where specified as appropriate for the application.

The Services Contractor shall ensure that all control systems operate in accordance with these performance requirements to provide a safe, reliable and economical operation of the Mechanical Service Systems in accordance with all current and relevant specifications, regulations, codes and Acts of Parliament, as stated elsewhere in this specification.

Where equipment and systems specified elsewhere in connection with the Works are not specifically referred to in the following Section H.4, the requirements as set out in H.3 shall be adopted.

Operation of engineering systems shall be in accordance with the Domestic Building Services Compliance Guide 2013 and the Department of Business, Energy and Industrial Strategy (BEIS) Regulation “Boiler Plus”.

Generally automatic control systems including function and safety controls, shall be integral with each item of equipment and the operation shall be as detailed by the manufacturer. Controls shall be easy to use, adjust and maintain.

The Services Contractor shall include for the supply and installation of all necessary controls equipment and for all necessary wiring, interconnections, relays, wiring centres and for setting the system up to provide fully automatic operation.

The boiler and space heating system shall be automatically controlled to provide controlled heat to each different room/space and the overall system shall be programmed to determine the ON and OFF periods for both heating and hot water generation with up to 4 ON/OFF periods available for each day.

The requirements of the boiler manufacturer shall be incorporated. Where necessary a heating pump run-on timer shall be provided to prevent overheating the boiler.

Where the boiler provides heating for both HWS generation and central heating, the boiler programmer shall provide at least 2 channel 7 day operation to provide simultaneous control of heating and hot water. For houses with more than one storey a 3 channel programmer shall be provided to control the heating time zones to bedrooms and dayrooms separately.

A frost protection control shall be provided to operate the space heating on set-back temperature when the external temperature drops to 3 deg. C or below. This shall be a switchable facility.

Where required by the boiler manufacturer the Services Contractor shall provide a direct acting pressure regulated bypass across boiler flow and return mains to maintain flow through the boiler in the event that radiator thermostatic valves restricted water flow.

The heating to each room/area shall be independently controlled to maintain the required space temperature.

Where the heating is provided by radiators the temperature control shall be by means of thermostatic radiator valves which shall be set either manually or remotely by means of wireless room thermostat as Honeywell Evotouch.

Where the heating is provided by underfloor heating the temperature control shall be by programmable room thermostat as Heatmiser wired back to relevant zonal solenoid valve on heating manifold. Where specified the temperature sensing shall be by thimble sensor acting through a remote programmable controller such as Heatmiser.

Where specified the temperature control throughout the house shall be managed by a compatible centralised controller as Honeywell Evotouch, or Heatmiser using a local area network system. The central control system shall be capable of remote access by wireless internet using Web Browser.

Where the HWS is generated by primary LPHW coil within Indirect Cylinder, the temperature of the stored contents shall be controlled by 3-port 2-position solenoid valve on the LPHW supply controlled by secondary water thermostat.

H.4.2 Boiler and Direct Fired HWS Plant

H.4.2.1 Boiler Plant - Single Boiler Unit

Gas Supply Failure/Flame Failure/Electricity Supply Failure/Integral Flue Fan Failure Protection:
Boiler shall be complete with all necessary integral safety controls and interlocks.

Low Water Flow Protection:
Low flow protection is shall be provided by flow switch on water flow to boiler interlocked with boiler control circuit to shut down boiler in event of low heating water flow through boiler.

LPHW System Over-Temperature Protection:
Over-temperature protection shall be provided by integral manual re-set over-temperature thermostat interlocked with boiler control circuit to shut down boiler in event of high boiler flow water temperature.

LPHW System Over-Pressure Protection:
Where the heating system is un-vented and pressurised, over-pressure protection shall be provided by pressure switch interlocked with boiler controls to shut down boiler in event of high system pressure.

LPHW System Low Water Pressure Protection:
Where the heating system is un-vented and pressurised, low-pressure protection shall be provided by pressure switch interlocked with boiler controls to shut down boiler in event of low system pressure.

Heating Water Temperature Control:
Heating water (LPHW) temperature control shall be provided by integral thermostat to maintain flow water temperature by controlling boiler operation.

Programmed Operation:
Boiler operation shall be controlled by 7-day electronic time switch with battery reserve. Over-ride control shall be provided with Timed/ON/OFF functions.

Heating System Make-Up:
Unless otherwise specified, the system make up shall be by provision of mains water fill point.

H.4.2.2 Multiple Boiler or Modular Boiler Plant

Not Applicable

H.4.2.3 Gas Fired HWS Domestic Water Heaters

Gas Supply Failure/Flame Failure/Electricity Supply Failure/Integral Flue Fan Failure Protection:
Heater shall be complete with all necessary integral safety controls and interlocks.

HWS System Over-Temperature Protection:
Over-temperature protection shall be provided by integral manual re-set over-temperature thermostat interlocked with heater control circuit to shut down heater in event of high secondary water temperature.

HWS Water Temperature Control:
Secondary water (HWS) temperature control shall be provided by integral thermostat to maintain design stored water temperature by controlling heater operation.

Programmed Operation:
Heater operation shall be controlled by 7-day electronic time switch with battery reserve. Over-ride control to be provided with Timed/ON/OFF functions.

H.4.3 Heating Systems

H.4.3.1 Frost Protection

Where specified, frost protection shall be provided to override the boiler programmer/timer to operate the heating system in the event of both cold external and cold internal temperatures. An external thermostat shall operate the boiler when external temperature drops to 0 (zero) deg. C and below. An internal thermostat shall operate the heating system when the internal temperature drops to 10 deg. C and below. An override switch shall be provided is disable the frost protection system.

H.4.3.2 Weather Compensated LPHW Heating Circuits

Where Weather Compensated Controls are specified, refer to Section H.3.3.2 for requirements.

H.4.3.3 Constant Temperature Heating Circuits

Temperature Control
Each circuit shall be controlled to maintain constant heating flow and return temperatures. The space temperature shall be controlled by varying the heat output of the heater by means of local direct acting or electronic/electric controls

Programmed Operation:
Heating operation shall be controlled by 7-day electronic time switch with battery reserve. Over-ride control shall be provided with Timed/ON/OFF functions. Heating programmer shall be interlocked with boiler operation.

Automatic Pump Change-Over:
Where run and standby pumps or twin/duplex pumps are specified, these shall be arranged for automatic change-over such that on failure of the run pump, the standby pump shall automatically be operated. Pump failure shall be determined by both motor trip condition and by differential pressure switch. The control systems shall also allow for routine automatic change-over of run pump every 7 days to ensure even wear of pumps.

H.4.3.4 Constant Temperature LPHW to Secondary Blended Circuits

Underfloor Heating Circuits:
Primary LPHW from the boiler plant shall be circulated to each underfloor heating manifold. Each underfloor heating manifold shall be complete with integral pump and blending valve to maintain a constant temperature secondary heating circuit to serve the underfloor heating circuits.

Space Temperature Control:
Each room or zone shall be provided with separately controlled heating system with two-port manifold zonal control valve which shall respond to zonal temperature sensors/thermostats to maintain room temperature. Unless otherwise stated, bathrooms shall be controlled by means of both floor surface temperature sensor and air temperature sensor acting through a dual Heatmiser PRT TS controller and all other rooms shall be controlled by means of a thimble type temperature sensor acting through a Heatmiser PRT TS type controller.

H.4.3.5 Primary Heating to HWS Cylinders

Temperature Control
Each circuit shall be controlled to maintain constant heating flow and return temperatures. The secondary water temperature shall be controlled by varying the heat input to the Cylinder by means of local direct acting or electronic/electric controls

Programmed Operation:
Heating operation shall be controlled by 7-day electronic time switch with battery reserve. Over-ride control shall be provided with Timed/ON/OFF functions. Heating programmer shall be interlocked with boiler operation.

HWS Water Temperature Control:
Secondary water (HWS) temperature of each heater shall be individually controlled by immersion thermostat acting through a proportional controller to Open/Close control valve on LPHW supply to maintain design storage temperature.

H.4.3.6 Solar Heating to HWS Cylinders

Temperature Control
Temperature of the water supply from the solar panels is subject to solar heat input and so will vary according to environmental conditions.

Programmed Operation:
The Solar Heating system shall be available to operate at all times other than when operation is to overridden by thermal controls to limit stored water temperatures and when operation would be counter-productive due to potential heat loss from the solar panels.

HWS Water Temperature Control:
The Solar Heating installation shall be complete with a thermal control/pumping system which shall respond to stored HWS temperature within each cylinder to control heat input to prevent overheating stored water. Each cylinder shall be separately monitored and controlled. Maximum stored water temperature shall not exceed 65degC at point of supply.

H.4.3.7 LPHW Air Heater Coils

Where air heater coils are specified, refer to Section H.3.3.7 for requirements.

H.4.4 Room Heaters

H.4.4.1 LPHW Fan Convectors, Over Door Heaters and Unit Heaters without Fan Speed Control

Space Temperature Control:
Space temperature control shall be provided by either Weather Compensated Heating control to vary the LPHW supply to all radiators within a zone, or by direct acting thermostatic control valves or electronic valves installed at each heater or by both as specified.

Programmed Operation:
Heating operation shall be controlled by 7-day electronic time switch with battery reserve. Over-ride control shall be provided with Timed/ON/OFF functions. Heating programmer shall be interlocked with boiler operation.

Space Temperature Control:
A room temperature sensor shall act through a proportional controller to modulate the 3 port/ 4 port control valve on the LPHW supply to the heating coil to maintain room temperature. The fan shall either run continuously as dictated by time switch control or shall run only when the control calls for heating as dictated by time switch control as specified.

H.4.4.2 LPHW Fan Convectors and Fan Assisted Trench Heaters with Fan Speed Control

Space Temperature Control:
Space temperature control shall be provided by either Weather Compensated Heating control to vary the LPHW supply to all radiators within a zone, or by direct acting thermostatic control valves or electronic valves installed at each heater or by both as specified.

Two Stage Space Temperature Control:
A room temperature sensor located in return air to unit shall act through a P+I controller to modulate in the 3 port/ 4 port control valve on the LPHW supply to the heating coil and as the second stage shall operate the fan by either variable speed control gradually ramping from zero to full speed or by fan speed step control with 3 or more steps to maintain room temperature. An adjustable dead band shall be provided to avoid system hunting. A remote set point potentiometer shall be provided within the space controlled.

H.4.4.3 LPHW Radiators, Natural Convectors, and Towel Rails

Space Temperature Control:
Space temperature control shall be provided by direct acting thermostatic radiator control valves or electronic radiator valves installed at each heater. In addition where specified Weather Compensated Heating control shall be provided to vary the LPHW supply to all radiators within a zone.

Control by Thermostatic Radiator Valves (TRV):
Radiators and Convectors shall each be fitted with direct acting TRVs. In the case of encased radiators and convectors and convector trench heaters remote sensing/set point adjustment shall be provided. Where towel rails are provided as a means of space heating, these shall be fitted with TRVs; otherwise manual valve control shall be provided.

Control by Electronic Radiator Valve (ERV):
Radiators and Convectors shall each be fitted with ERVs. A room temperature sensor shall act through a proportional controller to modulate the 2 port ERV. Where more than one heater is installed in the same room, the ERV on each heater shall be controlled in unison in response to a single room sensor. Where specified the temperature sensor shall incorporate set point adjustment, otherwise set point adjustment shall be provided at the control centre.

Towel Rails:
Where towel rails are provided as a means of space heating, these shall be fitted with TRVs; otherwise manual valve control shall be provided.

Pressure Relief Control:
Pumped heating circuits serving radiators and convectors fitted with TRVs and/or with ERVs shall be provided with pressure relief bypass across main flow and return mains pipework comprising pressure relief bypass valve set to operate to maintain minimum circuit flow rate.

H.4.4.4 LPHW Underfloor Heating Circuits

Space Temperature Control:
Each room or zone shall be provided with separately controlled heating system with two-port manifold zonal control valve which shall respond to zonal temperature sensors/thermostats to maintain room temperature. Unless otherwise stated, bathrooms shall be controlled by means of both floor surface temperature sensor and air temperature sensor acting through a dual Heatmiser PRT TS controller and all other rooms shall be controlled by means of a thimble type temperature sensor acting through a Heatmiser PRT TS type controller.

Programmed Operation:
Heating operation shall be controlled by 7-day electronic time switch with battery reserve. Over-ride control shall be provided with Timed/ON/OFF functions. Heating programmer shall be interlocked with boiler operation.

H.4.5 Central Cooling Plant

Where Central Cooling Plant is specified, refer to Section H.3.5 for requirements.

H.4.6 HVAC Central Plant

Where HVAC Central Plant is specified, refer to Section H.3.6 for requirements.

H.4.7 Air Conditioning Room Terminal Units

H.4.7.1 4 Pipe Fan Coil Units

Where 4 Pipe Fan Coil Units are specified, refer to Section H.3.7.1 for requirements.

H.4.7.2 DX Room Heating & Cooling Units

Room Temperature Control:
All thermal and fan speed controls shall be integral with the terminal unit. The Services Contractor shall fix the room user controller to the agreed position and extend and connect the control wiring back to the unit as required.

H.4.8 Mechanical Ventilation Equipment

H.4.8.1 Supply Air Systems

Where Supply Air Plants are specified, refer to Section H.3.8.1 for requirements.

H.4.8.2 General Extract Systems

Fan Speed Control:
Where specified, fan speed control by inverter controller shall be provided. Inverter controllers shall be panel mounted with local user speed control. Where specified high and/or low speed limits shall be electrically set.

Supply & Extract Systems – Interlocked:
Where supply and extract systems serve common areas the supply and extract fans shall be interlocked such that the extract fan must be operational before the supply fan may be operated.

Programmed Operation:
The operation of each Extract System, other than Car Park/Smoke Extraction and Kitchen Extraction, shall be controlled by 7-day electronic time switch with battery reserve unless specified to the contrary. Over-ride control to be provided Timed/ON/OFF functions.

H.4.8.3 Toilet and Bathroom Extract Systems

Toilet and bathroom extract systems shall be locally controlled by PIR or by local lighting circuit operation as specified elsewhere. Fans shall be arranged to continue to operate for 15 minutes after toilet or bathroom has been vacated.

Where fan speed controller is specified this shall be integral with the extract fan. Fans shall be wired from the local electrical circuits with local fused spur isolation.

Control of Kitchen extractor hoods shall by integral on/off and fan speed control switches. Kitchen and Utility extractor fans shall be provided integral on/off and speed control switches with humidistat override. User fan speed control shall be extended to wall switch/pull cord as required.

H.4.8.4 Kitchen Extract Systems

Where Kitchen Extract System are specified, refer to Section H.3.8.4 for requirements.

H.4.8.5 Car Park/Smoke Extract Systems

Where Car Park/Smoke Extract Systems are specified, refer to Section H.3.8.5 for requirements.

H.4.8.6 Smoke Control, Fire Alarm Interface and Fire Officer Controls

Where Smoke Control, Fire Alarm Interface and Fire Officer Controls are specified, refer to Section H.3.8.6 for requirements.

H.4.9 Domestic Water Services

H.4.9.1 Domestic Hot Water Services

HWS System Over-Temperature Protection:
Over-temperature protection shall be provided by integral manual re-set over-temperature thermostat interlocked with heater control circuit to shut down heater in event of high secondary water temperature.

HWS Water Temperature Control:
Secondary water (HWS) temperature control shall be provided by integral thermostat to maintain design stored water temperature by controlling heater operation.

Programmed Operation:
Heater operation shall be controlled by 7-day electronic time switch with battery reserve. Over-ride control to be provided with Timed/ON/OFF functions.

HWS Heaters - Blended Secondary Water Temperature Control:
Where control of maximum water temperature is specified for Health & Safety reasons, this shall be automatically limited to 43 deg. C at point of use by means of direct acting thermostatic blending valve fitted as near to the point of use as practical.

HWS Secondary Pumps:
Where specified, secondary circulation pumps shall be controlled by 7-day electronic time switch with battery reserve. Operation of pump to be interlocked with HWS primary pump, HWS controls and boiler plant.

HWS Pipework Trace Heating - Alternative to Secondary Circulation where specified:
Electric trace heating system to be self-regulating type arranged to operate continuously to maintain water temperature above 50deg C.

H.4.9.2 Domestic Cold Water Services

Tank Water Level Control:
Where tanks are filled by means of electric/electronic control valve, this shall be controlled by a low level sensor to open valve and a high level sensor to close valve. In addition a high level alarm sensor shall be provided to activate an emergency shut off valve in the water supply to the tank. Where tanks provide a water supply to booster and pressurisation sets a low water level sensor shall be provided in the tank which shall be extended to interface with the booster/pressurisation set controls to inhibit pump operation under low water conditions.

Cold Water Booster Sets:
Cold water booster sets shall be complete with integral controls to maintain design system pressure. Safety interlocks shall be provided to inhibit operation in event of low feed tank water level.

Cold Water Services Pipework Trace Heating - Frost Protection:
Electric trace heating system shall be operated by dedicated external thermostats to switch system on at 5degC and below to maintain pipework water temperature above 5 deg. C.

Water Treatment Systems:
Water treatment systems shall be complete with all necessary integral controls.

H.4.10 Electrical Heating Equipment

HWS Immersion Heaters:
HWS immersion heaters for use in storage cylinders shall be 240Vand have a maximum rating of 3kW. Immersion heaters shall be complete with integral adjustable thermostat wired to directly switch the heater electrical load and shall be complete with thermal cut out with manual reset. The heaters shall be set to maintain a stored water temperature of 60 deg. C.

Fan Heaters:
Fan heaters shall be complete with all necessary integral controls including heat output and fan speed as appropriate and shall incorporate thermal cut out with manual reset. Where specified heaters shall be provided with integral thermostat, user temperature control, and low limit on/off control. Where remote user controls are specified the Services Contractor shall fix the controls to the agreed position and extend and connect necessary wiring services back to the unit.

Radiators/Panel Heaters:
Radiators/panel heaters shall be complete with all necessary integral controls and shall incorporate thermal cut out with manual reset. Where specified heaters shall be provided with integral thermostat, user temperature control, time switch programmer and low limit on/off control. Where remote user controls are specified the Services Contractor shall fix the controls to the agreed position and extend and connect necessary wiring services back to the unit.

Towel Rails:

Towel rails shall be complete with all necessary integral controls.

H.4.11 Fire Fighting Systems

Not Applicable

H.4.12 Building Management Systems

Not Applicable

H.5 SCHEDULE OF CONTROLS EQUIPMENT

H.5.1 General

The following Schedule of Controls Equipment is based on equipment manufactured by Landis And Staefa Controls, Honeywell Controls Systems or equal. Relays and interlocks are not scheduled and shall be provided as necessary to achieve the specified description of operation. Some items listed below, particularly the controller units, contactors and starters shall be panel mounted.

H.6 CONTROL PANELS

Not Applicable