



# Belle Vue Co-op Academy

## Mechanical Services

### Mechanical Services Specification

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## **PART 1 PROJECT SPECIFIC REQUIREMENTS**

### **1.1 Introduction**

- 1.1.1 This Specification describes the scope of the installation in relation to this particular system and should be read in conjunction with the remainder of the Specifications and the Drawings. Together they cover the design, manufacture, supply, delivery to site, off-loading and positioning, co-ordination, erection, testing, setting to work and commissioning of the electrical services installation.

### **1.2 The Building**

- 1.2.1 Belle Vue Academy is a new teaching facility for children of secondary school age.
- 1.2.2 The 3-storey, 8,610m<sup>2</sup> building will be surrounded by a car park and sports pitch
- 1.2.3 The new building is to be constructed on a brownfield site off Hyde Road, Manchester. The local infrastructure in Hyde Road and Kirkmanshulme Lane for statutory services will be extended to serve the new building.

### **1.3 Design Philosophy**

- 1.3.1 The design philosophy for the mechanical and electrical services systems shall incorporate the following primary aims:
- a) Ensure compliance with statutory regulations and health and safety requirements (both during construction and the life of the new building).
  - b) Provide spatial flexibility to be able to alter accommodation provisions at a later date with minimum disruption.
  - c) To be suitable for the intended functions and use of the accommodation and integrated with the architectural/structural elements as much as possible.
  - d) Provide comfortable and user-friendly accommodation.
  - e) Simplicity of design for systems and their controls to reduce as much as possible the technical sophistication necessary to run the building satisfactorily.
  - f) The use of standardised equipment throughout the project.
  - g) The provision of easily and safely maintained plant for which spare parts and manufacturers support is readily available or obtainable without undue convenience or delay.
  - h) Co-ordination of the engineering systems with the building fabric to ensure that major maintenance is where practical not carried out from within occupied areas.
  - i) Particular emphasis to be placed on minimising the maintenance requirements together with minimising the range of spares needed to be held on site.

- j) Incorporate all features necessary to achieve the aim of low running cost and minimal energy use.
- k) Safety in use for occupants and maintenance staff.
- l) Be flexible for future modification and expansion.
- m) Be inherently reliable in use with acceptable levels of resiliency.
- n) Incorporate sufficient plant resiliency to accommodate equipment/plant failures with minimal disruption to the building operation.
- o) Building services solutions that ensure the effect on neighbouring properties during normal operation and plant/equipment shutdown or failure is minimised.

#### 1.4 Design Life

- 1.4.1 The design life of the electrical services plant and equipment shall be 20 years.

#### 1.5 LTHW Heating Systems

- 1.5.1 Reference should be made to the following Drawings and Technical Specifications:

LTHW Heating Drawings:

|                              |                                         |
|------------------------------|-----------------------------------------|
| 009433-IUL-01-00-DR-M-560001 | Level 00 - LTHW Heating Layout 1 of 2   |
| 009433-IUL-01-00-DR-M-560002 | Level 00 - LTHW Heating Layout 2 of 2   |
| 009433-IUL-01-01-DR-M-560001 | Level 01 - LTHW Heating Layout 1 of 2   |
| 009433-IUL-01-01-DR-M-560002 | Level 01 - LTHW Heating Layout 2 of 2   |
| 009433-IUL-01-02-DR-M-560001 | Level 02 - LTHW Heating Layout 1 of 2   |
| 009433-IUL-01-02-DR-M-560002 | Level 02 - LTHW Heating Layout 2 of 2   |
| 009433-IUL-01-03-DR-M-560001 | Roof Level - LTHW Heating Layout 1 of 2 |
| 009433-IUL-01-03-DR-M-560002 | Roof Level - LTHW Heating Layout 2 of 2 |
| 009433-IUL-01-ZZ-DR-M-560001 | LTHW Heating Schematic 1 of 4           |
| 009433-IUL-01-ZZ-DR-M-560002 | LTHW Heating Schematic 2 of 4           |
| 009433-IUL-01-ZZ-DR-M-560003 | LTHW Heating Schematic 3 of 4           |
| 009433-IUL-01-ZZ-DR-M-560004 | LTHW Heating Schematic 4 of 4           |

LTHW Heating Technical Schedules:

|                             |                                 |
|-----------------------------|---------------------------------|
| 009433-IUL-XX-ZZ-SP-M-56001 | SCH 01 - Gas Fired Boilers      |
| 009433-IUL-XX-ZZ-SP-M-56002 | SCH 02 - Pressurisation Unit    |
| 009433-IUL-XX-ZZ-SP-M-56003 | SCH 03 - LTHW Circulating Pumps |
| 009433-IUL-XX-ZZ-SP-M-56004 | SCH 04 - Radiant Panels         |
| 009433-IUL-XX-ZZ-SP-M-56005 | SCH 05 - Radiators              |
| 009433-IUL-XX-ZZ-SP-M-56006 | SCH 06 - Regulation of Flow     |

- 1.5.2 Low temperature hot water (LTHW) heating will be provided to the building using two gas fired condensing boilers as the primary heat source sized at 66% of the overall building load.

- 1.5.3 The boilers will operate as the heat source to serve a single constant (CT) pumped heating circuit producing heating at 80/60°C flow and return temperatures that will serve a system of radiators, radiant panels, and heating coils throughout the building.
- 1.5.4 Single heating primary circuit shunt pumps will be controlled to ensure that sufficient water flow is always circulated through the boilers to the building.
- 1.5.5 The building will be zoned on an individual floor level basis and configured to allow out of hours use for the building to the Sports Hall and Changing Rooms, and the Community Area of the building through local control valves monitored and controlled through the BMS.
- 1.5.6 Each emitter will be supplied with a pressure independent thermostatic radiator valve (PITRV) on the flow connection and matching isolation valve on the return connection.
- 1.5.7 In teaching spaces, the hybrid ventilation units will be fitted with individual heating coils. The CT heating circuit will extend to serve each unit with local temperature control through the ventilation unit controller located in each classroom.
- 1.5.8 The CT circuit will be extended to provide heating frost and heating coils within the air handling units. Three port control valves at each coil will control LTHW flow through the coils to maintain the off-coil design air temperature.
- 1.5.9 The heating system will be maintained under positive pressure by means of packaged pressurisation units with duty and standby pumps.
- 1.5.10 Conventional twin wall stainless steel open flues will discharge the products of combustion to atmosphere above roof level from the gas fired boiler. Mechanical ventilation will be provided for make- up and combustion air purposes via high and low-level louvres in the external plant room wall.
- 1.5.11 The entire heating system will operate under the dictates of the BMS to control operational times, temperature control and frost protection.

## 1.6 Ventilation Systems

- 1.6.1 Reference should be made to the following Drawings and Technical Specifications:

### Ventilation Drawings:

|                              |                                        |
|------------------------------|----------------------------------------|
| 009433-IUL-01-00-DR-M-570001 | Level 00 - Ventilation Layout 1 of 2   |
| 009433-IUL-01-00-DR-M-570002 | Level 00 - Ventilation Layout 2 of 2   |
| 009433-IUL-01-01-DR-M-570001 | Level 01 - Ventilation Layout 1 of 2   |
| 009433-IUL-01-01-DR-M-570002 | Level 01 - Ventilation Layout 2 of 2   |
| 009433-IUL-01-02-DR-M-570001 | Level 02 - Ventilation Layout 1 of 2   |
| 009433-IUL-01-02-DR-M-570002 | Level 02 - Ventilation Layout 2 of 2   |
| 009433-IUL-01-03-DR-M-570001 | Roof Level - Ventilation Layout 1 of 2 |
| 009433-IUL-01-03-DR-M-570002 | Roof Level - Ventilation Layout 2 of 2 |
| 009433-IUL-01-ZZ-DR-M-570001 | Ventilation Schematic 1 of 6           |
| 009433-IUL-01-ZZ-DR-M-570002 | Ventilation Schematic 2 of 6           |

|                              |                              |
|------------------------------|------------------------------|
| 009433-IUL-01-ZZ-DR-M-570003 | Ventilation Schematic 3 of 6 |
| 009433-IUL-01-ZZ-DR-M-570004 | Ventilation Schematic 4 of 6 |
| 009433-IUL-01-ZZ-DR-M-570005 | Ventilation Schematic 5 of 6 |
| 009433-IUL-01-ZZ-DR-M-570006 | Ventilation Schematic 6 of 6 |

#### Ventilation Technical Schedules:

|                              |                                               |
|------------------------------|-----------------------------------------------|
| 009433-IUL-XX-ZZ-SP-M-570001 | SCH 07 - AHU                                  |
| 009433-IUL-XX-ZZ-SP-M-570002 | SCH 08 - Heat Recovery Units                  |
| 009433-IUL-XX-ZZ-SP-M-570003 | SCH 09 - Extract Fans                         |
| 009433-IUL-XX-ZZ-SP-M-570004 | SCH 10 - Supply Diffusers and Extract Grilles |
| 009433-IUL-XX-ZZ-SP-M-570005 | SCH 11 - Monodraught Units                    |
| 009433-IUL-XX-ZZ-SP-M-570006 | SCH 12 - Windcatchers                         |
| 009433-IUL-XX-ZZ-SP-M-570007 | SCH 13 - Attenuators                          |

- 1.6.2 Non-teaching spaces afforded openable windows will be naturally ventilated.
- 1.6.3 Teaching spaces will be provided with hybrid natural ventilation units designed to control CO<sub>2</sub> levels within the spaces based on criteria detailed within the EFA Facilities Output Specification.
- 1.6.4 Mechanical ventilation will be provided through three air handling units located at roof level to serve the following large spaces:
- AHU/RF/01 – Main Hall and Activity Space  
 AHU/RF/02 – Dining Hall  
 AHU/RF/03 - Kitchen
- 1.6.5 Incoming fresh air will be filtered and heated within each AHU to provide treated supply air for respiration.
- 1.6.6 The air handling unit will also extract vitiated air and will be used to pre heat the supply air within the AHU/RF/01 & 02 using a plate heat exchanger as the heat recovery device.
- 1.6.7 AHU/RF/03 will be a supply unit only and will operate in conjunction with the dedicated kitchen extract fan KEF/RF/01.
- 1.6.8 The air handling units will comprise of the necessary filtration, heating and frost coils, heat recovery device (AHU/RF/01 & 02 only), variable speed supply and extract fans.
- 1.6.9 The units will operate under the dictates of CO<sub>2</sub> detectors and temperature detectors to provide an occupancy-based controlled mechanical ventilation system which will be designed to operate in accordance with the occupancy pattern of the space.
- 1.6.10 The air handling unit will connect to a system of supply and extract ductwork and strategically located grilles and diffusers within each space.

- 1.6.11 Local volume control and fire dampers will be provided within the system to allow for balancing and in accordance with Fire Officer requirements.
- 1.6.12 Sound attenuation will be provided on the intake and exhaust sections of the air handling unit to ensure noise levels are in accordance with local planning guidelines.
- 1.6.13 A dedicated kitchen extract fan will be provided to extract vitiated air from the Kitchen during cooking and preparation of food. The kitchen extract fan unit will connect to a kitchen extract canopy used to extract air locally from cooking and preparation areas.
- 1.6.14 Incoming fresh air will be filtered and heated within AHU/RF/o3 to provide treated supply air to the Kitchen as make up air to the Kitchen extract system. The system will be sized to provide 85% of the extract rate to maintain a negative pressure regime in the Kitchen.
- 1.6.15 The air handling unit will also provide fresh supply are to Kitchen ancillary areas as make up air for the extraction system.
- 1.6.16 The air handling unit and kitchen extract fan will operate under manual control to allow the system to operate under a cooking and preparation regime. The entire kitchen ventilation system will be connected to a gas safe system that will act as a safety device for the natural gas supply to the cooking appliances.
- 1.6.17 Local volume control and fire dampers will be provided within the supply system only, with fire rated extract ductwork incorporated where necessary on the extract system.
- 1.6.18 Sound attenuation will be provided on the intake and exhaust sections of the air handling units to ensure noise levels are in accordance with local planning guidelines. The kitchen extract system attenuators will be melenex lined.
- 1.6.19 In areas where mechanical ventilation is required due to location where the space is not afforded opening windows, or there is a requirement for mechanical ventilation through legislation, local ventilation heat recovery units will be provided.
- 1.6.20 The heat recovery units will be located in ceilings voids local to the areas served or at roof level as indicated on the ventilation layout and schematic drawings.
- 1.6.21 The units will operate under the dictates of time switch and will connect to a system of supply and extract ductwork and strategically located grilles and diffusers within each space.
- 1.6.22 Local volume control and fire dampers will be provided within the system to allow for balancing and in accordance with Fire Officer requirements.
- 1.6.23 Sound attenuation will be provided on the intake and exhaust sections of the air handling unit to ensure noise levels are in accordance with local planning guidelines.
- 1.6.24 Teaching spaces will be provided with a hybrid ventilation unit capable of operating in mechanical or natural ventilation mode.
- 1.6.25 The units will operate under the dictates of local controllers located within each classroom as follows:

Natural Ventilation – during occupied periods when the external air temperature is above the minimum set point or indoor air quality requires ventilation the unit will modulate to provide natural ventilation through the system.

Mixed Mode - during occupied periods when the external air temperature is below the minimum set point or indoor air quality requires ventilation the unit will modulate to provide mixed ventilation through the system. It will supply ventilation proportionally, varying fan speed and damper control until optimum room CO<sub>2</sub> levels are reached.

Boost Mode – if internal temperature or CO<sub>2</sub> levels rise too high the system operates in boost mode until the levels drop to acceptable levels.

- 1.6.26 In Science Labs and Food Prep classrooms, two hybrid units will be provided to operate as fresh air make up during times when natural gas is being burned for practical subjects.
- 1.6.27 The ventilation system will be supplemented by external opening ventilators which will be manually opened to provide a source of natural ventilation when conditions exist to maintain temperature and CO<sub>2</sub> levels to acceptable standards.
- 1.6.28 The Sports Hall will be provided with roof mounted windcatcher type hybrid ventilation units. The units will provide fresh air year-round to the space under the dictates of an independent control system for the Sports Hall.
- 1.6.29 Toilet areas will be provided with local extract fans operating under occupancy control with run on timer.
- 1.6.30 WCs and showers will be provided with local extract fans operating under time schedule or light switch control and incorporating a run-on timer to allow a minimum of 20 minute duration extended run on.
- 1.6.31 Small local spaces currently afforded opening windows will utilise the windows to provide natural ventilation.
- 1.6.32 Cleaners Cupboards will be provided with a local extract designed to operate continuously.

## **1.7 Comfort Cooling**

- 1.7.1 Local refrigerant cooling will be provided in IT Classrooms, Server Room, and IT Hub Rooms.
- 1.7.2 The Server and IT Hub Rooms will be provided through individual split type systems and dedicated to the space served. The Server Room will be provided with a duty and standby arrangement consisting of two high wall mounted indoor cooling units connected through a system of refrigeration pipework to individual external air source heat pump condensers located on the external plant deck.
- 1.7.3 The systems will operate on a N+N by basis to provide resilience to the Server Room and be controlled under the dictates of a single temperature detector located within the Server Room.
- 1.7.4 Each system will be connected to the BMS with auto changeover, run and system fault and temperature monitored through the BMS.

- 1.7.5 The Hub Rooms will be provided with a single high wall mounted indoor cooling unit connected through a system of refrigeration pipework to individual external air source heat pump condenser located on the external plant deck.
- 1.7.6 Each Hub Room will be controlled under the dictates of a single temperature detector located within each Hub Room.
- 1.7.7 Each system will be connected to the BMS with auto changeover, run and system fault and temperature monitored through the BMS.
- 1.7.8 A variable refrigerant volume (VRF) system will be provided to serve the Reprographics Room, Second and Ground Floor IT Classrooms.
- 1.7.9 The Reprographics Rooms will be provided with a single high wall mounted indoor cooling unit connected through a system of refrigeration pipework to the VRF external air source heat pump condenser located on the external plant deck.
- 1.7.10 The IT Classrooms will be provided with ceiling type cassette indoor cooling units connected through a system of refrigeration pipework to the VRF external air source heat pump condenser located on the external plant deck.
- 1.7.11 Individual control to each space will be under the dictates of room temperature detectors. The VRF system will be connected to the BMS with auto changeover, run and system fault monitored through the BMS.

## 1.8 Domestic Hot & Cold Water

- 1.8.1 Reference should be made to the following Drawings and Technical Specifications:

### Domestic Hot & Cold Water Drawings:

|                              |                                         |
|------------------------------|-----------------------------------------|
| 009433-IUL-01-00-DR-P-530001 | Level 00 – Domestic Water Layout 1 of 2 |
| 009433-IUL-01-00-DR-P-530002 | Level 00 - Domestic Water Layout 2 of 2 |
| 009433-IUL-01-01-DR-P-530001 | Level 01 - Domestic Water Layout 1 of 2 |
| 009433-IUL-01-01-DR-P-530002 | Level 01 - Domestic Water Layout 2 of 2 |
| 009433-IUL-01-02-DR-P-530001 | Level 02 - Domestic Water Layout 1 of 2 |
| 009433-IUL-01-02-DR-P-530002 | Level 02 - Domestic Water Layout 2 of 2 |
| 009433-IUL-01-ZZ-DR-P-530001 | Domestic Water Schematic 1 of 2         |
| 009433-IUL-01-ZZ-DR-P-530002 | Domestic Water Schematic 2 of 2         |

### Domestic Hot & Cold Water Technical Schedules:

|                              |                                   |
|------------------------------|-----------------------------------|
| 009433-IUL-XX-ZZ-SP-M-530001 | SCH 14 – Water Storage Tank       |
| 009433-IUL-XX-ZZ-SP-M-530002 | SCH 15 – Gas Fired Water Heaters  |
| 009433-IUL-XX-ZZ-SP-M-530003 | SCH 16 – Cold Water Booster Pumps |
| 009433-IUL-XX-ZZ-SP-M-530004 | SCH 18 – Electric Water Heaters   |

- 1.8.2 A new mains water supply will be derived from the existing mains water supply in Hyde Road. At the site boundary a new pulsed output statutory water meter will be provided with

direct connection to the proposed Building Management System (BMS) to record consumption.

- 1.8.3 The new supply pipe will distribute below ground from the boundary meter outlet to the incoming location at the building perimeter. The supply pipe will be suitably sized and installed in Protectline pipework to protect the supply from below ground contamination.
- 1.8.4 Before entry to the building the supply main will be fitted with a pulsed meter which will be linked via the BMS to the boundary meter to monitor any leakage occurring on the buried external pipeline.
- 1.8.5 The supply will enter the building within the Ground Floor plant space with stop cock isolation, double regulation valve and drain valve in accordance with Local Water Authority By-laws.
- 1.8.6 The incoming supply will be fitted with a new pulsed output tenant sub-meter installed on the incoming supply to allow monitoring of usage. The meter will be provided with a direct connection to the BMS to record consumption.
- 1.8.7 The mains cold water supply will feed all cold water draw offs and provide a supply to the cold water storage tanks and gas fired hot water heaters. If required suitable water softening devices will be connected to ensure the water service is of an adequate quality for the use with the cooking appliances.
- 1.8.8 A potable boosted cold water supply will be provided to serve the building through the boosted cold water pumps. The supply will extend to serve all potable cold water draw off points within the building and provide the cold water supply to the gas fired water unvented heaters for hot water supply.
- 1.8.9 A dedicated Category (CAT) 5 cold water storage tank and booster set will be provided to serve the cold water draw offs in Laboratories, Kitchen, and external Bin Store.
- 1.8.10 The CAT 5 supply will also provide the cold feed to a range of electric water heaters within the laboratories.
- 1.8.11 Hot water will be provided through two unvented gas fired water heaters located within the First Floor Plant Room. The packaged units will be served by the boosted cold water supply, connected to the hot water service distribution system and will be provided with all integral unvented safety devices together and all necessary control equipment.
- 1.8.12 The hot water system will be a circulation system with primary flow and pumped secondary return within the hot water system. The secondary hot water return connections will be connected adjacent to the hot water draw off points to minimise sub-circuit 'dead legs' and limit excessive hot water draw off periods.
- 1.8.13 Insulated circulation pipelines will be distributed throughout the building to serve all draw off points.

- 1.8.14 Blending valves will be provided on the connections to wash hand basins to ensure the water outlet temperature does not exceed 43°C.
- 1.8.15 Every endeavour will be made to conceal pipelines in occupied areas. Where this is not possible, pipelines and fittings will be chromium plated.

## 1.9 Gas

- 1.9.1 Reference should be made to the following Drawings and Technical Specifications:

### Gas Drawings:

|                              |                                       |
|------------------------------|---------------------------------------|
| 009433-IUL-01-00-DR-M-540001 | Level 00 – Gas Services Layout 1 of 2 |
| 009433-IUL-01-00-DR-M-540002 | Level 00 - Gas Services Layout 2 of 2 |
| 009433-IUL-01-01-DR-M-540001 | Level 01 - Gas Services Layout 1 of 2 |
| 009433-IUL-01-02-DR-M-540001 | Level 02 - Gas Services Layout 1 of 2 |
| 009433-IUL-01-02-DR-M-540002 | Level 02 – Gas Services Layout 2 of 2 |
| 009433-IUL-01-ZZ-DR-M-540001 | Gas Schematic                         |

- 1.9.2 A new natural gas supply will be provided to serve the building from the local statutory supply in Hyde Road. The new supply will provide a gas service to a new pulsed output meter location sited at the building perimeter. The meter will be connected to the building BMS to record consumption.
- 1.9.3 The new supply pipe will distribute below ground from the meter outlet to the incoming location at the building perimeter. The supply pipe will be suitably sized and installed in MDPE for the entire length of the below ground installation.
- 1.9.4 The new gas service will enter the building within the Ground Floor plant space with local isolation and purge facilities at the building entry point.
- 1.9.5 From the incoming location the new supply will extend to serve all gas fired equipment within the building. The supply will distribute horizontally within the ceiling voids and through dedicated service risers to serve the Kitchen and First Floor Plant Space and Science labs and Prep Room.
- 1.9.6 In the event of the supply pipe being boxed in or distributed through unventilated voids, suitable ventilation will be provided to prevent the accumulation of gas in a confined space the event of leakage.
- 1.9.7 The supply will include all necessary safety equipment associated with a natural gas installation.

## 1.10 Above Ground Drainage

1.10.1 Reference should be made to the following Drawings and Technical Specifications:

### Above Ground Drainage Drawings:

|                              |                              |
|------------------------------|------------------------------|
| 009433-IUL-01-00-DR-P-520001 | Level 00 – AGD Layout 1 of 2 |
| 009433-IUL-01-00-DR-P-520002 | Level 00 - AGD Layout 2 of 2 |
| 009433-IUL-01-01-DR-P-520001 | Level 01 - AGD Layout 1 of 2 |
| 009433-IUL-01-01-DR-P-520002 | Level 01 - AGD Layout 2 of 2 |
| 009433-IUL-01-02-DR-P-520001 | Level 02 - AGD Layout 1 of 2 |
| 009433-IUL-01-02-DR-P-520002 | Level 02 - AGD Layout 2 of 2 |
| 009433-IUL-01-ZZ-DR-P-520001 | AGD Schematic 1 of 5         |
| 009433-IUL-01-ZZ-DR-P-520002 | AGD Schematic 2 of 5         |
| 009433-IUL-01-ZZ-DR-P-520003 | AGD Schematic 3 of 5         |
| 009433-IUL-01-ZZ-DR-P-520004 | AGD Schematic 4 of 5         |
| 009433-IUL-01-ZZ-DR-P-520005 | AGD Schematic 5 of 5         |

1.10.2 The above ground foul drainage pipework shall be designed to BS EN 12056 and Building Regulations Approved Document H.

1.10.3 Pipework, fittings, and accessories shall be installed to ensure that appliances drain quickly, quietly, and completely at all times, without nuisance or risk to health.

1.10.4 The above ground drainage system will be installed predominantly in UPVC pipework and fittings with the exception of the Science Labs where vulcathene pipework and fittings will be used from all appliances with connection to the UPVC system discharge stacks at each Laboratory.

1.10.5 Discharge shall be conveyed without crossflow, back-fall, leakage, or blockage.

1.10.6 All concealed pipework shall be easily accessible.

## 1.11 Automatic Controls

1.11.1 The building will be provided with a Building Management System (BMS).

1.11.2 The automatic controls system will be provided to the building for operation on an open system protocol throughout including proprietary plant controller systems.

1.11.3 A dedicated mechanical services control panel (MSCP) will be provided within the First floor Plant Room to serve mechanical services plant and equipment. Motor control centres (MCCs) will be located throughout the building to link the mechanical services plant and provide interface to the building BMS.

1.11.4 The building management system will control all the HVAC systems and incorporate the following basic functions:

- Energy efficient control of plant and systems including optimum start/stop.

- Remote manual and automatic stop/start of plant and systems.
  - Duty cycling and sharing of duplicate plant and equipment.
  - Accurate control of space conditions.
  - Status monitoring of plant and equipment.
  - Monitoring of system and plant failure and alarm conditions.
  - Adjustable sequenced start of plant and restart in the event of power failure.
  - Frost protection of the building
  - Safety interlocking of plant and equipment.
  - Metering of the water, gas, and electrical systems by taking pulsed outputs from the meters.
  - Graphical display of the readings will be provided.
- 1.11.5 A central operator's terminal will be provided (in a location to be confirmed) comprising visual display terminal, processor, keyboard, mouse, and printer to allow all HVAC systems to be presented in graphical form to allow the user to interrogate all control points, energy usage and functions. Alarms will be notified through this workstation.
- 1.11.6 The BMS will provide good control of the building engineering services to maintain the desired levels of service, comfort, and safety in an energy efficient manner.

## SECTION C – STANDARD SPECIFICATION

### PART 1 GENERAL TECHNICAL CLAUSES

#### 1.1 Definition of Terms

The word "shall" is mandatory.

The word "will" is informative.

The word "should" is advisory.

The word "provide" means supply and fix or install.

1.1.1 The words Contract and Contractor shall read as meaning Sub-Contract and Sub- Contractor when this Specification relates to a Sub-Contract.

1.1.2 This section of the Specification specifies the general quality of the Mechanical Services Installation. Section 3 and the accompanying drawings specify in detail the installation to be provided. All clauses in this section may not apply to this project and only those relevant to the works are applicable.

1.1.3 All work shown upon the drawings but not described in the Specification, or vice versa, shall be provided. The Contractor shall seek clarification of such matters prior to submitting a Tender.

#### 1.2 Standards and Regulations

1.2.1 The installation shall conform to all relevant and generally accepted Standards and Regulations which in all cases shall be the edition in current use including all amendments. The Contractors attention is particularly drawn to the following:

- a) The Health and Safety at Work Act 1974.
- b) Construction Design and Management Regulations (CDM) 2015
- c) British Standards.
- d) British Standards Codes of Practice.
- e) The Clean Air Act.
- f) Control of Pollution Act.
- g) Energy Conservation Act.
- h) Regulations Under the Factories Act.
- j) The Building Regulations
- k) The Gas Safety Regulations
- l) British Gas Corporation Codes of Practice.
- m) The 18th Edition IEE Regulations (BS 7671: 2018).
- n) The Electricity Supply Regulations 1988.

## SECTION C – STANDARD SPECIFICATION

- o) The Electricity at Work Regulations 1989.
- p) Any special requirements of the local Electricity, Gas or Water Undertakings and Fire Fighting Authority.
- q) The Control of Asbestos at Work Regulations 1987.
- r) The Pressure Systems and Transportable Gas Containers Regulations 1989.
- s) Environmental Protection Act 1990.

### 1.3 Handover Procedure

1.3.1 The installation will not be considered as complete and will not UNDER ANY CIRCUMSTANCES be accepted for handover until the following criteria are met.

- The installation in fully tested, inspected, commissioned and regulated as detailed in this Specification.
- Approved "As Installed" documentation has been provided to the Client's Representatives.

#### *Inspection, Testing, Commissioning and Regulation*

1.3.2 During the installation period the Contractor shall continuously check the whole of the works to ensure complete safety and compliance with the Specification. The works will from time to time be inspected by the Engineer and it should be noted such inspections will be of a general nature and therefore not be comprehensive. The responsibility for ensuring the works comply with the Specification is that of the Contractor.

1.3.3 All tests shall be carried out in accordance with the appropriate British Standard or as otherwise specified in this document.

1.3.4 Seven days' notice shall be given to the Engineer of all tests and the Engineer shall confirm whether the test will be witnessed.

1.3.5 The Contractor shall include for the cost of all energy consumed for all tests and shall provide all necessary instruments, plant and equipment, supervision, skilled and unskilled labour required for the site tests. The accuracy of the Contractor's instruments shall be demonstrated if deemed necessary.

1.3.6 The Contractor shall include for all fees charged by the Nominated Insurance Companies for supervision and examination at Works during construction of all pressure vessels and similar equipment.

1.3.7 Three copies of all Test Certificates shall be handed to the Engineer. The Contractor shall note that storage cylinders, indirect cylinders, calorifiers, pneumatic control systems, three-way valves etc. shall not be subject to hydraulic tests greater than the manufacturer's test pressure and if necessary, such special items shall be disconnected from the pipework system when this is being tested.

1.3.8 The installation may have to be tested in sections to suit building progress and the Contractor

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shall include for any number of these tests as may be required by the Engineer.

- 1.3.9 During the installation all liquid carrying pipework and upon completion of each section as determined by the Engineer, the installation shall be hydraulically tested to a pressure of 6.8 bar or twice the normal working pressure, whichever is the greater. The test shall be maintained for a period of sufficient time to enable the installation to be inspected, the minimum period being ONE HOUR. If the test fails during the above mentioned period, the defective joint shall be located, repaired and the system re-tested as described above.
- 1.3.10 The Contractor shall test the mains cold water installation in sections in accordance with the details previously described and in addition shall conform to any further tests which may be required by the Local Water Authority.
- 1.3.11 The whole of the gas installation shall be pressure tested by authorised personnel in accordance with IGE/UP/1 'Soundness Testing and Purging of Industrial and Commercial Gas Installation.
- 1.3.12 Underground pipework shall be tested prior to any backfilling of the trench takes place.
- 1.3.13 Tests shall be carried out by applying a test pressure of at least 1.5 x working pressure or 50mbar whichever is the greater.
- 1.3.14 If the installation fails, the pressure test remedial works shall be carried out and the whole of the installation retested. In the case of polyethylene pipework leaking joints shall be replaced with new sections of pipework and fittings.
- 1.3.15 The installation shall Regulated and Commissioned using the methods and procedures set out in the CIBSE Commissioning Codes:
- |     |   |                             |
|-----|---|-----------------------------|
| CCA | - | Air distribution systems    |
| CCB | - | Boiler plant                |
| CCC | - | Automatic controls          |
| CCR | - | Refrigeration systems       |
| CCW | - | Water distribution systems. |
- 1.3.16 Upon completion of the installation all valves shall be set to ensure the correct amount of fluid is circulating through all circuits.
- 1.3.17 The Contractor shall include in the tender for instruction of the persons appointed to run and maintain the plant. The instructions shall be carried out over a period of TWO WEEKS and during this time the Contractor shall advise the person appointed, the location and function of all items of plant and ancillary equipment throughout the building.
- 1.3.18 The Contractor shall ensure all pressure testing points are installed as the installation progresses.
- 1.3.19 Where routine tests are applied to plant before delivery to site, two copies of the relevant test certificates shall be forwarded to the Engineer.

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1.3.20 On certain occasions the Engineer may wish to witness tests carried out on plant before delivery to site. These instances will be detailed when required and the Contractor shall give at least seven days' notice in writing, of the date of these tests.

1.3.21 Two copies of all test certificates subsequently supplied to the Contractor by the manufacturer shall be supplied to the Engineer.

### *Spares*

1.3.22 The Contractor will be required to provide a number of spare parts and consumable items upon completion. A specific list of these items is contained in Section 3 of this Specification.

### *"As Installed" Documentation*

1.3.23 One copy of the "As Installed" documentation shall be submitted for approval at least 10 days prior to the anticipated handover date for comment and approval. The final documentation incorporating the Engineers comments shall be made available at handover.

1.3.24 Should the Contractor fail to produce the "As Installed" documentation to the Engineers approval at the date of practical completion the Client may instruct the Engineer to provide the drawings with whatever assistance the Engineer deems necessary and the cost of preparing the drawings will be deducted from the outstanding payments due to the Contractor.

### *Maintenance Manual*

1.3.25 The Contractor shall furnish to the Engineer upon practical completion of the complete installation, three copies of a Maintenance Manual.

1.3.26 The Manual shall be of the loose leaf type, A4 size having stiff covers, with sub- division for each section, a ready means of reference and a detailed index. The Manual shall contain full operating and maintenance instructions for each item of equipment and shall deal systematically with each system including the following:

- General description of installation
- Control panel wiring diagrams
- Wiring diagrams for each item of plant
- Plant
- Valve operating
- Description of controls operation including settings for control variables
- Procedure to adopt in an emergency
- Setting up and operating instructions for all installed equipment
- Procedure fault finding
- Maintenance requirements including frequency and details of routine maintenance including schedule of consumables
- Legend of colour coding for all services
- Schedule of manufacturers including address and telephone number
- List of recommended spares

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- Copies and schedules of the "As Installed" drawings and valvechecks
- Copy of test sheets, inspection, completion and commissioning certificates

Note:

Manufacturers' standard "hand out" cards and leaflets will be accepted in the Manual, but only as supporting information additional to the instructions detailed above.

### *"As Installed" Drawings and Charts*

- 1.3.27 During the progress of the works the Contractor shall record on drawings in an approved manner, the information necessary for preparing the "As Installed" drawings.
- 1.3.28 The marked-up drawings shall be made available to the Engineer for inspection and checking at any time during the Contract.
- 1.3.29 The "As Installed" drawings shall indicate:
- a) The exact positions of all plant and apparatus.
  - b) The size, type and routes of all pipework, conduits, trunking ductwork etc.
  - c) The size, type and date of laying of all underground services and ducts.
  - d) Schematic diagrams of distribution systems and control systems.
  - e) Position of all valves - valve reference numbers shall correspond to the reference numbers on valve labels.
  - f) A list of symbols, notation and nomenclature used.
  - g) General arrangement drawings shall be to a minimum scale of 1:50.
  - h) Plant Rooms and section 1.20.
  - i) In addition to the "As Installed" drawings, valve and instruction charts reproduced on suitable plastic materials shall be supplied and fixed in the Boiler House, Calorifier Rooms, and/ or Plant Rooms. All charts must be approved by the Engineer prior to final printing.
- 1.3.30 The Contractor shall provide printed instructions and "As Installed" drawings of plant control systems and equipment in sufficient detail to enable the Employer to operate, maintain, dismantle, re-assemble and adjust such plant and equipment.
- 1.3.31 The final "As Installed" drawings of the installation, together with any required Drawings or Instructions relating to the plant and equipment, shall be provided at Practical Completion.
- 1.3.32 "As Installed" drawings shall be in approved CAD format as specified.
- 1.3.33 The Contractor shall provide "As Installed" drawings in CAD format - AutoCad, .DWG format on CD(s) or DVD(s). Drawings shall be produced at a scale of one drawing unit to 1mm. Each engineering service shall constitute one layer and text shall be on a separate layer.
- 1.3.34 The Engineers design drawings may be available to the Contractor either in hard copy or AutoCad, DWG format as appropriate. An appropriate charge may be made for the provision of this service.

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### 1.4 Position and Neatness of Installation

- 1.4.1 The positions of all plant shown on the drawings will be used for the purposes of tendering, but the Contractor shall not scale the drawings for actual site installation.
- 1.4.2 The Contractor shall set out the works involved and take all measurements and dimensions required for the erection of plant on site, making any modification in detail as found necessary during the progress of the works.
- 1.4.3 The Contractor shall ascertain on site that the installation will not conflict with other services or furniture and any work requiring alteration due to negligence by the Contractor in this respect shall be at the Contractor's expense. Particular care shall be taken to obtain uniform and tidy arrangements of wall and ceiling mounted equipment.
- 1.4.4 Two or more items of equipment whether electrical or mechanical or both which are to be erected on the same wall or ceiling or which will be otherwise visually close to each other, shall be arranged in a neat and symmetrical group. Symmetry shall be obtained by horizontal and vertical alignment through the centre lines of the equipment.
- 1.4.5 In the planning of arrangements, the Contractor shall co-operate with the Main Contractor and any other Contractor involved. Exact positions of plant and equipment shall be marked out on site and agreed with the Engineer prior to installation and before any holes or chases are cut.
- 1.4.6 Failure to comply with this requirement may result in disruptions to other disciplines and the Contractor shall be held responsible for any additional expenditure involved in resolving the issue.

### 1.5 Contractors Working Drawings

- 1.5.1 The Contractor shall prepare his own working drawings. If any further instructions, details or drawings are required to enable these working drawings to be prepared or any work to be done, the Contractor shall apply in writing to the Engineer for such information.
- 1.5.2 The Contractor shall ensure that the working drawings are co-ordinated with other trades during their preparation.
- 1.5.3 Generally working drawings shall follow the guidance given in BSRIA Technical Note TN/22/97. The Contractor shall submit to the Engineer for comment, the following:
  - 1. on or before the dates named in the Specification such drawings as may be called for therein,
  - 2. during the progress of the "Services" and within such reasonable times as the Engineer may require, such drawings of the general arrangement and details of the "Services" or any part thereof as the Engineer may reasonably require.
- 1.5.4 Within a reasonable period after receiving such drawings, the Engineer shall identify his comments if appropriate.

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- 1.5.5 Two copies of all drawings which require comment by the Engineer shall be provided by the Contractor.
- 1.5.6 The Engineer shall appraise the drawings on a technical nature only in terms of the drawings being compatible with the intent of the design and comment by the Engineer shall not relieve in any way the Contractor from his responsibilities under this Contract, in respect of the accuracy of drawings or the relationship of the drawing content in terms of co-ordination of other trades.
- 1.5.7 Drawings signed as above described shall not be departed from except as provided by an Official Instruction.
- 1.5.8 The Engineer shall have the right at all reasonable times to inspect at the Premises of the Contractor, all drawings of any portion of the "Services".
- 1.5.9 In the event of any discrepancies in the scale approved to any plan or drawing and the figured dimensions thereon, the figured dimensions shall be taken and held to be correct.
- 1.5.10 The Contractor shall be responsible for and shall pay the extra cost, if any, occasioned by any discrepancy, error or omissions in the drawings and other particulars supplied by him, whether "commented on" the Engineer or not, provided that such discrepancies, errors or omissions are not due to inaccurate information or particulars furnished in writing to the Contractor by the Employer or Engineer.
- 1.6 British Standards**
  - 1.6.1 All British Standards referred to in this Specification shall include all the latest amendments.

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### PART 2 LTHW HEATING INSTALLATIONS

#### 2.1 General

2.1.1 The installation shall conform to all relevant British Standards and Codes of Practice which are current at the time of installation tender. The Contractors attention is particularly drawn to the following:-

- |                   |                                                                                        |
|-------------------|----------------------------------------------------------------------------------------|
| (a) BS 6644: 1991 | Installation of gas fired hot water boilers of rated inputs between 60 kW and 2 MW .   |
| (b) BS 6798: 1987 | Installation of gas fired hot water boiler of rated input not exceeding 60 kW .        |
| (c) CP 6680 Parts | Low temperature hot water heating 1, 2 & 3: 1988 systems of output greater than 45 kW. |

#### 2.2 Boiler Plant

2.2.1 The Contractor shall provide and fix on prepared foundations heating boiler plant as detailed later in the Specification. Boilers of cast iron construction shall comply with BS 779 and welded mild steel construction shall comply with BS 855. Atmospheric gas or forced draught gas or oil burning equipment shall be used as detailed later in the Specification, gas fired equipment shall be installed in accordance with BS 6644 and BS 6798 and oil fired in accordance with BS 5410.

2.2.2 The following mountings and fittings shall be provided on each boiler or on the connecting pipework adjacent each boiler:-

- a) No. 1 combined altitude gauge and thermometer, direct mounting as BSS. Fig. EG100 or equal and approved, which shall be located in the flow connection.
- b) No. 1 safety valve as described in Clause 2.2.13 A copper drain full bore size shall be fitted to the safety valve and this shall discharge within 150mm of the boiler house floor where floor drainage is provided or into a 100mm dia tundish which in turn shall be connected to the main drainage system.
- c) An isolating valve shall be provided on each flow and return connection equal in size to the connection.
- d) No. 1 - 20mm draincock with hose union.
- e) One set of flue brushers.
- f) The cold feed connection to the boiler plant shall be complete with a lockshield pattern isolating valve of equal size to the cold feed.

2.2.3 Each boiler shall be complete with a purpose designed flue/chimney system which shall comply with the manufacturer's recommendations, BS 4076 and BS 5854.

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### 2.3 Radiators

- 2.3.1 The Contractor shall provide and fix in the positions indicated upon the drawings and detailed in the schedule of radiators manufactured in accordance with BS 3528 which shall be supported from the structure on manufactures purpose made brackets. The location and number of brackets used for each radiator shall be as recommended by the manufacturers.
- 2.3.2 Radiator connections shall be either TBOE or BOE as identified in the schedule.
- 2.3.3 A minimum clearance of 150mm shall be provided between the radiator and the floor and 40mm between the radiator and wall surface. Radiators shall be positioned on the centre line of windows whenever possible. The Contractor shall, before placing an order, check that each radiator will fit in the space allocated.
- 2.3.4 Each radiator shall be fitted with 6mm air vent cock.
- 2.3.5 All radiators shall be removed once to facilitate decoration of walls then re-fixed vented and finally set to work.

### 2.4 Pipework and Fittings

- 2.4.1 Pipework shall be black mild steel manufactured in accordance with BS 1387 "Heavy". All joints on pipework 65mm and over shall be welded in accordance with HVCA Code of Practice TR/5, straight lengths with butt welded joints, bends shall be formed using standard radius seamless steel welding bends and branches by seamless steel branch bends. Branches for air vents, draincocks, thermostats, thermometers, pressure gauges and the like shall be formed by welding either a threaded socket or nipple to the pipeline. Where changes in diameter occur seamless steel eccentric welding sockets shall be used to ensure correct venting and draining of the installation. All bends and branch bends shall have an inside radius of at least one and one half pipe diameters.
- 2.4.2 Flanged joints shall be provided for disconnection purposes and for connections to items of plant, valves etc.
- 2.4.3 Pipework shall be black mild steel manufactured in accordance with BS 1387 - 1957 "Heavy". All joints on pipework 50mm and below shall be screwed, straight lengths with screwed sockets, bends shall be formed using long radius malleable bends and branches using long radius malleable swept tees or twin elbows. Branches for air vents, draincocks, thermostats, thermometers, pressure gauges and the like shall be formed using square malleable screwed fittings. Where changes in diameter occur reducing tees or eccentric reducing sockets shall be used to ensure correct venting and the draining of the installation. Changes in diameter shall not be achieved using bushes.
- 2.4.4 Screwed joints shall be made watertight using PTFE tape or long hemp and jointing compound in accordance with BS 5292. All surplus jointing material shall be cleaned from the joint immediately after assembly.

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**2.4.5** All pipework and fittings shall be in accordance with the following Schedule of Technical Requirements, Table 1.

**Table 1 Schedule of Technical Requirements**

| CARBON STEEL PIPES (NOT GALVANISED). SCREWED, FLANGED OR WELDED JOINTS |                  |                                                                  |                                                                                                                                    |                           |
|------------------------------------------------------------------------|------------------|------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| WORKING PRESSURE 3.5 bar.g                                             |                  | TEMPERATURE - NOMINAL 95°C                                       |                                                                                                                                    |                           |
| ITEM                                                                   | NOMINAL SIZE     | DESCRIPTION                                                      | BRITISH STANDARDS                                                                                                                  | NOTES                     |
| Pipe                                                                   | 15 to 100        | Screwed BS 21 1985                                               | 1387 1985(1990) AMD<br>5830 5/89 Table 4                                                                                           | Heavy                     |
|                                                                        | 25 to 125        | Plain ends                                                       | 1387 1985(1990) AMD<br>5830 5/89 Table 4                                                                                           | Heavy                     |
| Fittings                                                               | 15 to 100        | Malleable cast iron<br>Reinforced pattern.<br>Screwed BS 21.     | 143 & 1256 1986                                                                                                                    |                           |
|                                                                        | 15 to 100        | Steel sockets. Screwed<br>BS 21                                  | AMD 5542, 7692 6632<br>12/90, 7692c 4/93                                                                                           |                           |
|                                                                        | 25 to 300        | Carbon steel butt<br>welded fittings.<br>Seamless                | 1740 : 1971 (1990) AMD<br>4170 2/83, 5517 3/87,<br>4170 2/83, 5517 3/87,<br>6240 5/90,<br>1965 1963 (1983) Part 1<br>AMD 4169 2/83 | Thickness to suit<br>tube |
| Unions                                                                 | 15 to 50         | Malleable cast iron.<br>Ground- in spherical<br>seats of bronze. | Makers Standards                                                                                                                   |                           |
| Steel Flanges                                                          | 65 to 100        | Screwed boss type.                                               | 4504 Part 3 Section 3.1:<br>1989, AMD6610, 9/90,<br>6334 1/91, 7555 6/93                                                           | Screwed on.               |
|                                                                        | 25 - 300         | Slip-on boss type.<br>Flanges PN6 bar.                           |                                                                                                                                    | Welded on.                |
| Gaskets at<br>flanges                                                  | All sizes metric | Flat sheet or metal<br>type joint rings.                         | 4865 : 1989                                                                                                                        | Asbestos free             |

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### 2.5 Cold Feed and Open Vent Pipework

- 2.5.1 All cold feed and open vent pipework shall be copper in accordance with BS EN 1057: 1996 assembled using capillary fittings up to 76mm bore and weldable fittings 108mm bore and overall in accordance with BS 864 Part 2.
- 2.5.2 All fittings shall be resistant to dezincification and comply with the requirements of the local Water Undertaking.
- 2.5.3 Compression ring type fittings in accordance with BS 864 Part 2 shall be used for disconnection purposes. Pipework and fittings shall be in accordance with the Schedule of Technical Requirements, Table 3.

### 2.6 Pipework Installation (General Requirements)

- 2.6.1 Pipework of all sizes which is installed in service voids, floor ducts all suspended ceiling voids or any other inaccessible location shall be welded as described in Clause 2.2.4 of this Specification.
- 2.6.2 Where pipework passes through any part of the building structure an oversized mild steel pipe sleeve shall be fitted and built into the structure. Space between the sleeve and pipe shall be fire stopped using an approved fire resistant packing material. In exposed locations the assembly shall be finished off with a chromium plated wall or floor plate. Before assembly all burrs, rust, scale and other defects shall be removed and the Engineer will instruct the removal and dismantling of six sections of pipework for demonstration purposes if deemed necessary.
- 2.6.3 All open ends shall be sealed during the progress of the works using purpose made metal or wooden plugs.
- 2.6.4 Pipework shall be installed horizontally or vertically as appropriate and shall follow the lines of the building structure. Where pipework is visible in rooms all changes of direction shall be achieved using proprietary fittings rather than from offsets. In concealed locations machine or hand formed bends and offsets are to be used where appropriate. The pipe bore in such bends shall not be restricted and any "kinking" of the pipework will not be accepted.
- 2.6.5 A minimum clearance of 40mm shall be maintained at all times between the wall finish and the surface of the pipe or its insulation.
- 2.6.6 Pipework shall be installed to form a gradient to facilitate draining and entrained air to escape from the system.
- 2.6.7 Allowance shall be made for expansion and contraction of the pipework using changes of direction or in the case of straight runs by the use of expansion loops or joints and by offsets in branches at the point of connection to the mains. Adequate allowance for expansion shall also be made where pipework is connected to items of plant and equipment. Joints shall not be formed within the thickness of any wall, floors or ceiling and pipework shall not be

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embedded within the building structure unless specifically agreed in writing with the Engineer.

- 2.6.8 Pipework shall be installed in accordance with British Standard Code of Practice for low temperature hot water heating systems of output greater than 45kW - CP 688o Part 3 Installation, Commissioning and Maintenance.

### 2.7 Pipework Supports

- 2.7.1 Pipe supports shall be arranged to ensure free movement of pipework when expanding and contracting except where there is a need to anchor pipework. All vertical pipework shall be supported at its base using a purpose made support details of which shall be submitted to the Engineer prior to fabrication, for comment. This shall be in addition to the support brackets distributed throughout its length. Supports for pipework 50mm and under shall consist of a malleable iron split munsen ring with pipe stem which shall be built into or fixed to the structure using a malleable backplate and screws. Pipework 65mm dia and over shall be supported on purpose made mild steel stirrups with cast iron rollers supported from a primary suspension. Pipes shall not be supported from one another unless such an arrangement is agreed, in writing with the Engineer.
- 2.7.2 Where pipework services are grouped together they shall be supported from secondary steelwork rather than individual fixings to the structure.
- 2.7.3 Detailed drawings of all pipework supports shall be submitted to the Engineer for comment prior to fabrication.
- 2.7.4 Pipework shall be supported from the structure at intervals not exceeding those set out in Table 2.

**Table 2 Schedule of Technical Requirements - Pipework Supports**

| Size of Pipe mm | Horizontal m | Vertical m |
|-----------------|--------------|------------|
| 15              | 1.8          | 2.4        |
| 20              | 2.4          | 3          |
| 25              | 2.4          | 3          |
| 32              | 2.4          | 3          |
| 40              | 2.4          | 3.7        |
| 50              | 2.4          | 3.7        |
| 65              | 3            | 4.6        |
| 80              | 3            | 4.6        |
| 100             | 3            | 4.6        |

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|     |     |     |
|-----|-----|-----|
| 125 | 3.7 | 5.5 |
| 150 | 4.5 | 5.5 |

### 2.8 Feed and Expansion Cistern

- 2.8.1 The Contractor shall provide and fix in the position indicated upon the drawing a galvanised mild steel feed and expansion cistern complete with a close fitting cover in accordance with BS 1564. The cistern and all its connections shall be in accordance with CIBSE Guide Section B16 and the Local Water Supply Bye-Laws, all pipework being of copper as described earlier. Overflow pipework shall be laid to falls to ensure free flow, shall discharge clear of the building in a visible position and be complete with a 0.65mm mesh screen.
- 2.8.2 The cistern shall be insulated on each side and on the cover (the bottom shall be left uninsulated) with 25mm thick foil backed rigid phenolic foam slabs applied with adhesive and secured with stainless steel bands at 300mm centres. The quality and workmanship standards specified later in this document shall also apply to the insulation of cisterns.

### 2.9 Pressurisation Equipment

- 2.9.1 The Contractor shall provide and fix in the position indicated upon the drawings and as detailed later in the Specification, a sealed diaphragm vessel packaged pressurisation unit. The unit shall be mounted on a common base frame, be self-contained, with provision for a simple connection to the boiler plant and the automatic control system.
- 2.9.2 The unit shall be complete with feed water connections, holding tank, duplicate pumps, expansion vessel, heating system connections and all necessary controls, safety devices and power connection, all of which shall be arranged to fail safe. The expansion vessel shall be constructed in accordance with BS 4814 and shall be complete with replaceable diaphragm. The duplicate transfer pumps shall be controlled to provide manual selection of duty pump and auto-changeover in the event of duty pump failure. In addition, the standby pump shall start if the duty pump fails to maintain the set pressure.
- 2.9.3 All overflow and drain pipework shall be run from the unit to the nearest floor gulley copper pipework as specified elsewhere in this Specification.
- 2.9.4 Each pump shall be complete with a strainer, non-return valve and isolating valves. Low and high pressure alarm signals shall be provided by the control system and these shall be used to automatically switch off the boiler plant in the event of low pressure. The alarm contacts shall be volt free.

### 2.10 Valves

- 2.10.1 Valves shall be installed in pipelines for the purpose of isolation and regulating the flow of fluid, they shall have screwed ends up to and including 50mm dia and flanged ends when 65mm dia and over.

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- 2.10.2 Isolating valves shall be installed on the pipework connections to all boilers, heat exchangers, circulating pumps, pipeline strainers, control valves and where shown upon the drawings.
- 2.10.3 Regulating valves shall be installed on all main branches, three port control valve by- pass connections and where shown upon the drawings.
- 2.10.4 Non return valves shall be installed on the delivery side of all circulating pumps and where shown upon the drawing.
- 2.10.5 Angle pattern isolating valves shall be provided on flow and return connections to all radiators.
- 2.10.6 Drain valves shall be installed where shown upon the drawings and at all low points to enable the whole system to be completely drained.
- 2.10.7 Valves shall comply with the following British Standard Specification for the temperature pressure of the installation.

### Type

### British Standards

|                                                       |                   |
|-------------------------------------------------------|-------------------|
| Radiator Valves                                       | BS 2767           |
| Cast Iron Wedge & Double Disc Gate Valves             | BS 5150           |
| Cast Iron Parallel Slide Gate Valves                  | BS 5151 Cast Iron |
| Globe and Globe Stop and Check Valves                 | BS 5152 Copper    |
| Alloy W edge, Double Disc, Parallel Slide Gate Valves | BS 5154           |
| Copper Alloy Globe Valves                             | BS 5154           |
| Butterfly Valves                                      | BS 5155           |
| Cast Iron Plug Valves                                 | BS 5158           |
| Cast Iron Ball Valves                                 | BS 5159           |

The Contractor shall utilise lever or lockshield valves as required to correctly balance the systems.

#### 1. Isolating Valves

Isolating valves up to 40mm shall be DZR Crane D171AEXS or D171ALS ball valves with polished ball and PTFE seats, taper threaded to BS 21 PN16 rating. Valves shall have quarter turn operation using a lever or lockshield with key as applicable.

Isolating valves 50mm and above shall be Crane Challenger cast iron butterfly valves with EPDM body lining and trigger level operation. Valves shall be suitable for connections to flange to BS 4504 to PN16 rating.

#### 2. Radiator Valves

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Valves for all radiators, shall be Pegler Belmont complete with drain off facility. Valves shall have chrome finish only where exposed and be suitable for screwed connection into steel pipe. Wheel head valves shall be used on flow connection and lockshield valves on return.

### 3. Draincocks

Draincocks shall be DZR Crane D171HULS of the ball valve pattern to BS2879, with inlet end screwed to BS 21 taper thread, ribbed outlet suitable for hose attachment complete with lockshield type head. Three lockshield keys to be provided for each size of draincock installed.

### 4. Regulation Valves

Regulating valves shall be Crane D920 or DM920 threaded to BS 21 or flanged to BS 4504 as applicable with PN16 rating, comply with BS 5152 or BS 5154 as relevant for low pressure loss or variable low pressure loss applications and shall have proportioned characterised plugs and indicators or indicators of a type where a pointer moves over a scale permanently fixed to the main structure of the valve. They shall also incorporate a facility to prevent opening beyond pre-set limits.

### 5. Commissioning Valve Sets

Close coupled commissioning valve sets shall be Crane D941 or DM940 comprising double regulating valve and fixed orifice flow measurement device.

Commissioning sets for balancing the water flow between circuits shall provide flow measurement accuracy to within + 5% under the service conditions.

Valves shall be threaded to BS 21 or flanged to BS 4504 as applicable with PN16 rating.

Regulating devices shall be installed at the downstream ends of circuits and isolating valves at the upstream ends.

### 6. Flow Measurement Devices

Flow measuring devices up to 50mm shall be Crane D901 of DZR Construction screwed to BS 21 PN20. Flow measuring devices 65mm and above shall be Crane DM900 of stainless steel construction flanged to BS4504.

### 7. Strainers

Strainers shall be Crane F2273 or FM276 malleable iron screwed to BS 21 or flanged to BS 4504 Y type with 0.75mm stainless steel perforated strainer element and bolted or screwed cap as applicable.

### 8. Non Return Valves

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Valves shall be Crane D138 bronze or FM45 cast iron swing pattern type screwed to BS 21 or for flanges to BS 4504 PN16. The disk shall be cast iron with an EPDM rubber facing.

### 9. Automatic Balancing Valves

Automatic balancing valves shall be Crane D970 or D975 as indicated on the schedules and on the drawings.

The Contractor may substitute the manufacturers named in this clause of the Specification with Messrs Hattersley Newman Hender.

### **2.11 Drains**

- 2.11.1 All drain pipework shall be carried out in light gauge copper tube in accordance with BS EN 1057: 1996 assembled using compression ring type fittings in accordance with BS 864 Part 2.
- 2.11.2 All drain pipework shall be run to falls and be installed generally as described in Clause 2.3.2 of this Specification. An air break and running trap shall be provided at all connections to the main drainage installation.

### **2.12 Air Vents and Eliminators**

- 2.12.1 The Contractor shall provide and fix at all high points in the system 6mm dia bronze air cocks lockshield pattern treaded to BS 21. Air cocks shall be positioned to enable all entrapped air to be removed from the system after the initial filling.
- 2.12.2 The Contractor shall in addition provide and fix in the common return pipe before connecting the boiler a Spirovent Deaerator as follows :-  
  
Where the static head above the unit is less than 5m a Spirovent Air Dirt type SV2 combined micro bubble deaerator and dirt separator shall be installed.  
  
Where the static head above the unit is 5m or more a Spirovent Superior active deaerator shall be used together with a Spirovent Dirt type SV3 dirt separator.
- 2.12.3 The Deaerator and Dirt Separator shall be as detailed in Section 3 of the Specification and shall be manufactured by Spirotech b.v., or equal and approved.
- 2.12.4 The Contractor shall provide and fix in the positions shown upon the drawings float operated type automatic air vents each complete with quarter turn isolating valve. The automatic air vent shall be "Spirotop" as manufactured by Engineering Appliances or equal and approved and shall be complete with a copper drain/discharge pipe which terminates in a safe location approved by the Engineer.
- 2.12.5 All drain/drip pipework shall be run in copper pipework as described in Clause 2.2.11.

### **2.13 Safety Valves**

- 2.13.1 The Contractor shall provide and fix in the flow pipe from each boiler or calorifier a high lift combined pressure and temperature safety valve as manufactured by National Vulcan Safety

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Products Limited. The safety valve shall be selected in accordance with BS 6759: Part 1: 1984 and the minimum size permitted for use is 20mm.

- 2.13.2 The set pressure of the safety valve shall be 0.7 bar or 10%, whichever is greater, above the normal working pressure of the system. The set temperature of the safety valve shall be 95oC.
- 2.13.3 A copper discharge pipe, equal in size to the safety valve, shall discharge in a 100mm dia copper tundish at low level which in turn shall be connected to a copper drain which discharges safely into a plant room floor gulley or drain stack as shown upon the drawings.
- 2.13.4 All drain and discharge pipework shall be in accordance with Clause 2.3.11 of this Specification.

### 2.14 Flexible Connections

- 2.14.1 The Contractor shall provide and fix where described below and indicated upon the drawings flexible connections as manufactured by Engineering Appliances Limited. Flexible connections shall be constructed from low profile reinforced rubber held in position by metal locking rings and shall be complete with flanged end connections. Tie bars shall be fitted where necessary.
- 2.14.2 Flexible connections shall be suitable for a working pressure and temperature of 10 bar and 100oC and shall be installed in the following locations:-
  - Flow and return connections to air handling unit heat exchange coils.
  - Suction and delivery connections of circulating pumps having a drive motor of 1kW and over.
- 2.14.3 The Contractor shall note where flexible connections are used on circulating pumps, the pump body shall also be supported independently from the structure using anti-vibration mountings.

### 2.15 Pressure Measurement

- 2.15.1 The Contractor shall provide and fix on the suction and delivery connections of each circulating pump set, and where indicated upon the drawings or Specification a 100mm dia dial Altitude Gauge complete with brass syphon pipe, gauge cock and case to comply with BS 1780. The scale range of altitude gauges shall be agreed with the Engineer prior to placing orders. The gauge shall have a dual scale reading bar and metres H<sub>2</sub>O with a range appropriate for the working pressure of the system.

### 2.16 Temperature Measurement

- 2.16.1 The Contractor shall provide and fix on the flow and return to each pumped circuit, the flow and return connection to each boiler and where indicated upon the drawings or the Specification 100mm dia dial clearway temperature gauge in accordance with BS 5235 rigid stem type with 120mm stainless steel pocket, which complies with BS 2765. The thermometer shall have a scale range of 20oC to 120oC.

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### 2.17 Expansion

- 2.17.1 Thermal expansion of pipework shall whenever possible be absorbed by the natural offset and changes of direction of pipe runs. Where this is not possible expansion joints of either the axial or angular variety shall be installed in the position shown upon the drawings. These shall be Powerflex type RFA axial compensator or Powerflex type RFL angular compensator manufactured from stainless steel with mild steel flanged ends or equal and approved.
- 2.17.2 The expansion joints shall be complete with associated anchors, and guide points all of which must comply with the manufacturer's recommendations.

### 2.18 Water Treatment

- 2.18.1 The Contractor shall provide and fix in the position shown upon the drawing a welded mild steel dosage pot manufactured to AOTC requirement and as manufactured by Houseman Limited or equal and approved. The dosage pot shall be 3.5 litre or 13.5 litre as detailed in Section 3 of this Specification it shall be complete with Funnel, Pot, 15mm interconnecting pipework and isolating valves. The dosage pot shall be connected across the system flow and return pipework and shall be installed in accordance with the manufacturer's recommendations.
- 2.18.2 The Contractor shall ensure the system is thoroughly flushed out and all strainers are cleaned following testing and before it is filled with clean water. Once the system is filled the Contractor shall arrange for a water sample to be taken and analysed by an approved water treatment specialist who shall then provide a water treatment regime which shall then be introduced into the system. The Contractor shall provide the water treatment specialist with details of any materials within the system which may react with the treated water. Upon completion of the water treatment the specialist shall produce a detailed analysis of the system water together with recommendations for future treatment. This shall be incorporated in the maintenance manual.
- 2.18.3 The Contractor shall include in his tender the cost of all labour and materials including chemicals for the work described above.

### 2.19 Valve Labels and Wall Chart

- 2.19.1 The Contractor shall provide and fix to all valves in the plant room the following identification labels:- Each valve shall have a 25mm diameter traffolyte disc.
- 2.19.2 All labels shall be drilled to facilitate fixing to the valves by means of a key ring. The Contractor shall produce a diagrammatic chart, enclosed in a glazed frame showing the function of all valves together with an indexed list of valves.
- 2.19.3 The chart and valve label sample shall be submitted to the Engineer for comment.

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### 2.20 Painting and Finishing Off the Works

- 2.20.1 As the installation progresses all ferrous components shall be thoroughly wire brushed and cleaned of all dirt, rust, paper labels and grease etc. All welded joints shall be cleaned and be free from surplus slag. All surplus jointing materials shall be removed and all edges and corners made safe to the entire satisfaction of the Engineer.
- 2.20.2 The foregoing work shall be carried out prior to the progression of any further work either by the Contractor or any other Contractor which shall conceal the materials in question. After cleaning, one coat of anti-corrosive primer of an approved manufacture shall be applied.
- 2.20.3 The Contractor shall note that this applies to all MS pipes, fittings, steel supports and unpainted plant.
- 2.20.4 All exposed MS pipework, metalwork, brackets etc. with the exception of aluminium or galvanised items shall be given one coat of undercoat and one coat of heat resistant paint of an approved colour.
- 2.20.5 Upon final completion the whole of the works shall be thoroughly cleaned to remove all building debris, insulation and paint splashes. After cleaning, if damage is apparent it shall be repaired to the satisfaction of the Engineer.
- 2.20.6 The Contractor shall ensure that all exposed copper pipework in the plant room shall be cleaned of all jointing compounds, flux, excess solder, polished and given two coats of clear lacquer.

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### PART 3 HOT AND COLD WATER SERVICES INSTALLATION

#### 3.1 General

- 3.1.1 The installation shall conform to all relevant British Standards and Codes of Practice which are current at the time of installation. The Contractors attention is particularly drawn to BS 6700 - Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages.
- 3.1.2 All materials used in Hot and Cold Water Services Installation shall be approved by the Water Research Centre.

#### 3.2 Pipework and Fittings

- 3.2.1 All water supply pipework shall be carried out in accordance with BS EN 1057: 1996. All fittings shall be Yorkshire potable capillary type. Bends and elbows on copper pipework size 15mm and 22mm shall be kept to a minimum and the Contractor shall allow for the bending and setting of pipework wherever possible. On pipework 28mm and over bends shall be used in preference to setting of pipework and the use of elbows.
- 3.2.2 The Contractor shall provide and fix on the connection to each wash hand basin, sink, WC, urinal cistern a Ballofix valve as manufactured by Yorkshire Imperial Metals Limited.
- 3.2.3 All pipes shall be reamed to the full bore of the pipe. The Contractor shall ensure pipework levels are correct.
- 3.2.4 No joints shall be allowed within the thickness of walls, floors, partitions etc. except where such arrangements would prevent the pipe from maintaining the specified projection from the wall.
- 3.2.5 All pipes in plant rooms, under floors, in roof spaces, in false ceilings and a high level are to be supported on swinging type hangers, fixed to the floor slab or steelwork.
- 3.2.6 All pipes in room shall be supported by cast brass screw fixed clips.
- 3.2.7 All metal supports, screws, bolts etc. and the drilling to angle iron bearers are to be provided by the Contractor who shall be responsible for the accurate setting out of these.
- 3.2.8 All pipes shall be supported at the following intervals:
- |                       |   |      |
|-----------------------|---|------|
| 15 and 22mm           | : | 1.2m |
| 28mm                  | : | 2.0m |
| 32mm to 54mm and over | : | 2.4m |
- 3.2.9 The Contractor shall note that all exposed pipework, fittings and brackets shall be chromium plated.
- 3.2.10 The installation requirements for this pipework shall be in all respects in accordance with the requirements for the LTHW Heating Installation.

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- 3.2.11 Provide and fix where pipes pass through walls, floors, ceilings etc. a loose fitting pipe sleeve flush with the wall, floor or ceiling and complete with a chromium plated wall or floor plate.
- 3.2.12 The space between pipe and sleeve shall be fire stopped using an approved fire retardant material.
- 3.2.13 The Contractor shall, if deemed necessary during the progress of the installation, be prepared to employ registered plumbers for the installation of copper pipework.
- 3.2.14 The final connections to all sinks, basins and fittings shall be provided by the Contractor who will provide suitable BSPT copper adaptors and the Contractor shall note that all taps shall be supplied under a separate contract.
- 3.2.15 The Contractor shall also note that the use of Hemp and Paste for jointing in hot and cold water systems will not be allowed under any circumstances. Any screwed joints can be made using PTFE tape, however he must obtain written approval to do so from the Engineer.
- 3.2.16 The Contractor shall ensure that where dissimilar metals are used within the pipework installation they do not result in chemical reaction or electrolytic action.
- 3.2.17 All pipework and fittings shall be in accordance with the following Schedule of Technical Requirements Table 1.

**Table 1 Schedule of Technical Requirements**

| <b>COPPER PIPES. CAPILLARY OR FLANGED JOINTS</b> |                                |                                                                                                  |                                   |                                                                                                                |
|--------------------------------------------------|--------------------------------|--------------------------------------------------------------------------------------------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------|
| <b>WORKING PRESSURE 6 bar. g max</b>             |                                |                                                                                                  | <b>TEMPERATURE - NOMINAL 65°C</b> |                                                                                                                |
| <b>ITEM</b>                                      | <b>NOMINAL SIZE</b>            | <b>DESCRIPTION</b>                                                                               | <b>BRITISH STANDARD</b>           | <b>NOTES</b>                                                                                                   |
| Pipe                                             | All sizes mm<br>O.D. 15 to 159 | Copper tube. Half hard tube.                                                                     | BS EN: 1057:1996<br>Table X       | Material to BS 6017 non-arsenical and de-oxidised grade.                                                       |
| Fittings                                         | 15 to 108                      | Copper or non-dezincifiable copper alloy. Capillary type with integral "lead free" solder rings. | BS 864: 1982 Part 2               | Fittings to be marked by manufacturer to identify as having "lead free" solder. IMI Yorkshire Fittings Limited |
| Fittings                                         | 15 to 108                      | Brass compression fittings.                                                                      | BS 864: 1982 Part 2               |                                                                                                                |

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| COPPER PIPES. CAPILLARY OR FLANGED JOINTS |                  |                                                                                        |                            |                                                                                 |
|-------------------------------------------|------------------|----------------------------------------------------------------------------------------|----------------------------|---------------------------------------------------------------------------------|
| WORKING PRESSURE 6 bar. g max             |                  |                                                                                        | TEMPERATURE - NOMINAL 65°C |                                                                                 |
| ITEM                                      | NOMINAL SIZE     | DESCRIPTION                                                                            | BRITISH STANDARD           | NOTES                                                                           |
| Unions                                    | 15 to 54         | Non-dezincifiable copper alloy. Capillary type with integral "lead free" solder rings. | 864 Part 2                 | Fittings to be marked by manufacturer to identify as having "lead free" solder. |
| Gaskets at flanges                        | All sizes metric | Ethylene propylene synthetic rubber.                                                   | 4865 Part 1                | To the approval of WRC tests.                                                   |

### Notes:

Flux shall be as recommended by the fitting manufacturer and be approved by the Water Authorities Association as suitable for hot "potable" water services to Water Research Centre tests. Flux shall be applied sparingly, be water miscible and flushed away as soon as possible in accordance with the manufacturer's recommendations.

### 3.3 Valves and Stopcocks

- 3.3.1 Isolating valves shall be installed on the pipework connections to all heat exchanged, pressurisation equipment, tanks, strainers, mixing valves, pressure reducing valves and where shown upon the drawing.
- 3.3.2 Check valves shall be installed on the delivering side of circulating pumps, inlet side of mixing and pressure reducing valves and where shown upon the drawing.
- 3.3.3 Drain cocks shall be installed at all low points to enable the whole system to be completely drained and where shown upon the drawing.
- 3.3.4 A means of isolation using a stopcock shall also be provided to all draw off points and final connection point of all appliances which consume water.

#### *Isolating Valves*

- 3.3.5 Crane D171A or D171ALS DZR copper alloy ball type threaded to BS 21 PN25. Valve to be quarter turn lever operation or lockshield as required for system balancing.

#### *Check Valves*

- 3.3.6 Crane D140 bronze swing type with renewable nitrile rubber disk and screwed in cap, threaded to BS 21 PN25.

#### *Strainers*

- 3.3.7 Crane D297 bronze Y type strainer screwed BS 21 with copper screen and screwed cap.

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### *Drain cocks*

- 3.3.8 Drain taps shall be DZR Crane D171HULS of the ball valve pattern to BS 2879, with inlet end screwed to BS 21 taper thread, ribbed outlet suitable for hose attachment complete with lockshield type head. Three lockshield keys to be provided for each size of draincock installed.

### *Stopcocks*

- 3.3.9 Standard Ballofix valves sized 15 and 22mm with compression ends brass finish where concealed and chrome finish when exposed.
- 3.3.10 Yorkshire YP514GM double union stopcock on sizes 28mm and over.

### *Pressure Reducing Valves*

- 3.3.11 IMI Bailey Birkett type, of bronze construction.
- 3.3.12 The Contractor may substitute the manufacturers named in this section of the Specification with Messrs. Hattersley Newman Hender.
- 3.3.13 The Contractor shall note an approximately sized anti-vacuum valve shall be fitted to all pressure vessels installed within the HWS system.

### *Flexible Hoses*

- 3.3.14 Flexible connections shall be used to connect portable equipment such as vending machines. Flexible hoses shall be braided chromium finish complete with suitable connections.

## **3.4 Water Storage Tank (Sectional)**

- 3.4.1 The Contractor shall provide and fix in the position shown water storage tank as detailed in Section 3 and on the drawings. The storage tank shall be complete with screened overflow and warning pipe which shall be taken to discharge in an external visible position.
- 3.4.2 The inlet cold water feed connections to the cold water storage tank shall be complete with an isolating valve and float valve. The float valve shall be fitted above the overflow outlet connection and shall be adjusted to ensure the water line is at the specified distance from the top of the tank.
- 3.4.3 The tank shall be fitted with a delayed action float valves.
- 3.4.4 Each float valve shall be complete with line size 'Filterball' spherical isolating valve with integral strainer. Float valves shall be suitable for the pressure of the installation.
- 3.4.5 The tank shall have a fully self-draining base, bolted lid, man way and inspection hatch. The tank shall be mounted on supports to the manufacturer's requirements.
- 3.4.6 All connections shall be of sufficient length so as to project clear of the finished face of the storage tank to facilitate ease of disconnection.

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- 3.4.7 The sectional tank shall have external flanged joints suitably sealed during erection with a sealing compound recommended by the manufacturer. The flanges of each tank shall be jointed using mild steel nuts, bolts and washers, galvanised in accordance with BS 729.
- 3.4.8 The tank shall be complete with internal 304 quality stainless steel stays to prevent distortion as recommended by the manufacturer. Internal ties shall be utilised as necessary to structurally stabilise the tank.
- 3.4.9 Sectional tanks shall be constructed from non-toxic glass reinforced polyester material (GRP). The panels shall be manufactured with a raised centre and shall be hot press moulded at 140EC. The panel shall have flanges 80mm deep, precision drilled to suit M12 bolts. The panels shall be complete with mitred corners to reduce the possibility of localised areas of high internal stress. The loads in the tank shall be taken by stiffened flanges and supports. All panels shall be factory drilled.
- 3.4.10 The material shall be medium pale blue/grey colour including 25% polyester resin and UV stabilisers to BS 5734 Part 5.
- 3.4.11 Tank panels shall be pre-insulated with 25mm cfc free foam insulation, truncated pyramid shaped with smooth internal and external surfaces. The panels shall have 100% panel surface insulation.
- 3.4.12 The tank panels shall have a thermal conductivity of 0.87 W/m<sup>2</sup>K
- 3.4.13 The tank shall be externally braced with galvanised steel supports using the manufacturers recommended method in accordance with BS 4994.
- 3.4.14 Assembly of tank panels shall be means of 12mm galvanised mild steel finished bolts to BS 729 with internally bolted heavy duty cover. Sides shall be externally bolted, and the base shall be externally bolted. Internal fasteners shall be stainless steel 304 quality.
- 3.4.15 Aqualite sealant used in the assembly of the tank shall be butyl rubber compound minimum 3mm thick 75mm wide with minimum 25% recovery from compression.
- 3.4.16 The testing of the tank shall be undertaken on completion of the installation. There shall be no visible sign of water leakage for minimum period of 24 hours.
- 3.4.17 The tank shall have a 300mm raised ball valve chamber of sufficient size to house both float valves. The drain connection shall be taken from the bottom of the tank.
- 3.4.18 The design, manufacture and installation of the tank and connecting pipework shall comply with the Water Supply Byelaws Guide and the latest British Standard.

### 3.5 Water Storage Tank (One Piece)

- 3.5.1 The Contractor shall provide and fix in the position shown one piece glass reinforced plastic water storage tank as detailed in Section 3 and on the drawings. The storage tank shall be complete with screened overflow and warning pipe which shall be taken to discharge in an external visible position.

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- 3.5.2 The cold water feed connection to the tank shall be complete with a line size 'Filterball' spherical service valve and a delayed action float valve which shall be suitable for the existing water pressure.
- 3.5.3 The tank shall be complete with a close fitting mechanically fixed rigid cover with built in screened breather (0.65mm mesh). Both tank and lid shall be insulated in integral encapsulated insulation at 0.87W/m<sup>2</sup>K minimum.
- 3.5.4 The design, manufacture and installation of the tank and connecting pipework shall comply with the Water Supply Byelaws Guide and the latest British Standard.

### 3.6 Valve Labels and Wall Chart

- 3.6.1 All major valves shall be labelled and included in the wall chart as specified in Clause 2.2.19 of this Specification.

### 3.7 Chlorination

- 3.7.1 The hot and cold water pipework shall be sterilised in accordance with BS 6700, 1987 and the following notes:

- a) The following sterilisation procedure shall be applied when serving complete domestic hot water and cold water installation.
  1. Ensure that all equipment is shut off and disconnected from system at mains/branch pipework connections prior to sterilisation.
  2. Preparation of the sterilisation solution shall be carried out in the following manner and in accordance with the system capacities given in the Specification and dosage data hereunder.
- b) Hatacide C.R. (Chlorine) tablets to be inserted into the cold water storage tanks.

Note: 1 No. Hatacide C tablet to every 800 gallon system capacity.

1. Allow time for tablets to dissolve (normally 30 minutes). Leave the whole system charged for a period of not less than three hours.
2. Open all taps and allow sterilising solution to flush through the system and carry out a residual chlorine test to determine when solution is apparent at all outlets.
3. When solution is detected at outlets, shut down all taps installed on system.
4. Leave system in a shutdown situation fully charged, until final commissioning is carried out.
5. After sterilisation period, open all outlets and drain through, carry out residual chlorine tests until negative chlorine test is proved at all outlets.
6. Operate all domestic hot water plant and repeat chlorine test when system is up to temperature. Further draining may be necessary if chlorine is detected.

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7. When system is working with fresh (chlorine free) water, reconnect any appliances disconnected under item 1.

### 3.8 Water Authority Regulations

- 3.8.1 The Contractor shall liaise fully with the Local Water Authority and be fully conversant with the Local Water Authority Bye-Laws and Regulations before commencing any work and must make allowances for all things necessary to carry out the whole of the work covered under this Specification and the accompanying drawings, in accordance with these regulations whether specifically detailed herein or not. Allow for all testing and stamping charges involved.

### 3.9 Expansion

- 3.9.1 Thermal expansion of pipework shall be absorbed by expansion loops sets or bellow units as necessary and as indicated on the drawings.
  1. Expansion Loops
    - a. Expansion of pipework to be taken up by the natural offset and change of direction of pipe runs where this is not possible expansion devices to be adopted.
  2. Expansion Bellows
    - a. Expansion bellows shall be Powerflex RFA or RWA stainless steel Axial Compensator type as detailed on the drawings. They shall have suitable connections for copper pipe and shall be complete with outer protection sleeve.
    - b. Expansion bellows shall be designed to withstand the test pressure of the system.
    - c. Expansion bellows shall be installed in accordance with the manufacturer's recommendations complete with all necessary pipe guides and anchor points. Bellows shall be line size.

### 3.10 External Water Mains

- 3.10.1 The Contractor shall connect to the new metered water supply at the boundary of the site and run new pipework into the building as indicated upon the drawing. Buried potable blue medium density polyethylene for buried potable water distribution system. Pipes and fittings to be manufactured and tested in accordance with the Water Research Council Specification No. 4.32.03 for mains pipe (90mm and above) and 4.32.04 for fusion joints and fittings. Service pipe (20mm - 63mm) to be manufactured in accordance with BS 6572 by Wavin Industrial Products Limited or equal and approved.
- 3.10.2 For fusion welding the Engineer reserves the right to consult Wavin to ensure that installers are competent to handle PE pipework and fittings.

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### *Frost Protection*

- 3.10.3 All underground pipework and fittings shall be laid with a minimum cover of 750mm below finished ground level, and where entering buildings shall not rise above that level until they have reached a point not less than 750mm away from the internal face of any external wall.

### *Pipe Laying*

- 3.10.4 The Contractor shall lay all underground pipework with a minimum cover of 750mm below finished ground level and to a maximum depth of 1250mm.
- 3.10.5 Where practical the gradient shall not be less than 1:250.
- 3.10.6 No water service or distribution mains shall be made along a trench in which is laid any drain or sewer. Pipes shall not be laid in avoidable foul or injurious soil or other materials. Where laying of pipes in such materials is unavoidable, the pipes shall be protected.
- 3.10.7 No pipes shall be laid on their collars or bricks tiles or other temporary supports. If the bottom of the trench has been taken too low, it shall be made up with well rammed fill of ballast. Joint holes shall be formed in the bottom of the trench ahead of the work in order that joints may be properly made. The joint holes shall be as short as practical.
- 3.10.8 Where MDPE pipes are laid underground care shall be taken to ensure that the bed on which the pipes are laid and the backfilling immediately adjacent to the pipes does not contain any sharp edged stones. Backfilling of trenches shall be carried out carefully to avoid damage to pipework.
- 3.10.9 Pipes shall be kept free from mud, debris, superfluous jointing material or other obstructions during laying and until completion of the contract. Open pipe ends shall be temporarily sealed using purpose made metal or wooden plugs or blank counter flanges. Where necessary, pipework shall be weighted to prevent floatation. All pipes and fittings shall be thoroughly cleaned internally and maintained in a clean condition during pipe laying.
- 3.10.10 Trenching work concerned in the laying of underground pipework shall comply with the requirements of BS 8010. Constructions of trenches, their depth, line and gradient shall comply with the requirements of this Specification and the British Standards Codes of Practice before pipe laying commences. Thrust blocks complying with BS Codes of Practice shall also be provided at all bends, branches, changes in direction and dead ends, before filling and testing the installation. Thrust blocks shall be constructed out of concrete to British Standards.

### **3.11 Valves**

- 3.11.1 Stop valves shall be of brass construction with ends screwed or suitable for copper connections where specified. Stop valves shall conform to BS 1010 with crutch head.
- 3.11.2 Sluice or mains isolating valves shall conform to BS 5163 and be of the class suitable for the pressure in the main. The valves shall be double flanged pattern and where necessary shall be

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complete with cast iron spigot and socket adapters for either cast iron or uPVC or ABS pipework. Sluice valves fixed inside buildings shall be fitted with square cap suitable for normal turnkey operation.

### *Testing*

- 3.11.3 The pressure test shall not be commenced until a period of at least 24 hours has elapsed from the time of making the last pipe joint and all thrust blocks are complete.

### *Chlorination*

- 3.11.4 The external water main shall be chlorinated in accordance with Clause 2.3.8.

## **3.12 Painting and Finishing Off the Works**

- 3.12.1 As the installation progresses all ferrous components shall be thoroughly wire brushed and cleaned of all dirt, rust, paper labels and grease etc. All welded joints shall be cleaned and be free surplus slag. All surplus jointing materials shall be removed, and all edges and corners made safe to the entire satisfaction of the Engineer.
- 3.12.2 The foregoing work shall be carried out prior to the progression of any further work either by the Contractor or any other Contractor which shall conceal the materials in question.
- 3.12.3 After cleaning, one coat of anti-corrosive primer of an approved manufacture shall be applied.
- 3.12.4 The Contractor shall note that this applies to all MS pipes, fittings, steel supports and unpainted plant.
- 3.12.5 All exposed MS pipework, metalwork, brackets etc. with the exception of aluminium or galvanised items shall be given one coat of undercoat and one coat of heat resistant paint of an approved colour.
- 3.12.6 Upon final completion the whole of the works shall be thoroughly cleaned to remove all building debris, insulation and paint splashes. After cleaning, if damage is apparent it shall be repaired to the satisfaction of the Engineer.
- 3.12.7 The Contractor shall ensure that all exposed copper pipework in plant rooms shall be cleaned of all jointing compound, flux, excess solder, polished and given two coats of clear lacquer.

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### PART 4 NATURAL GAS INSTALLATION

#### 4.1 General

- 4.1.1 The Contractor shall supply, deliver, install and commission the natural gas installation as detailed in the Specification and on the drawings.
- 4.1.2 The Contractor shall include in his tender for liaising with the Gas Shipper to ensure the satisfactory provision of the supply and meter to the position shown upon the drawing.
- 4.1.3 The contract shall commence with the provision of the valved connection to the meter outlet shall include the provision of all underground and above ground pipework and the final valved connection to all gas appliances.
- 4.1.4 The installation shall be carried out by suitably qualified operatives experienced and certified to work on gas installations. The installation shall generally conform with British Gas Document IM/16 and Institution of Gas Engineers Document IGE/UP/2. The installation shall conform to all relevant British Standards and Codes of Practice which are current at the time of installation. The Contractors attention is particularly drawn to the following:-

|                                                     |   |                                                                                                      |
|-----------------------------------------------------|---|------------------------------------------------------------------------------------------------------|
| BS 6891                                             | - | Specification for installation of low pressure gas pipework up to 28mm diameter in domestic premises |
| BS 6400                                             | - | Specification for installation of domestic gasmeter                                                  |
| BS 7281                                             | - | Specification for polythene pipes for the supply of gaseous fuels                                    |
| BS 7336                                             | - | Specification for polythene fusion fittings for the supply of gaseous fuels                          |
| BS 8010                                             | - | Codes of Practice for Pipelines                                                                      |
| Gas Safety (Installation and Use) Regulations 1994. |   |                                                                                                      |

#### 4.2 Underground Pipework

- 4.2.1 All underground pipework shall be MDPE pipework, yellow medium density polyethylene conforming to Specification ISO 4437 BP Rigidex Polymer 002/40 BS7281: 1990 and BS 7336: 1990 as manufactured by Wavin Industrial Products Limited or equal and approved.
- 4.2.2 All joints shall be made using the fusion method as recommended by the manufacturer using electrical tooling and equipment to BGC/PS/PL.2Prt3. The Contractor shall demonstrate to the Engineer that all operatives are appropriately certified to install MDPE pipework.
- 4.2.3 Pipework shall be laid in compliance with BS 8010, the Gas Safety Regulations and shall have at least 150mm clearance from other services such as electric cables and drainage pipework.
- 4.2.4 MDPE pipework and the fittings shall be in accordance with the following Schedule of Technical Requirements Table 4.

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**Table 4 - Schedule of Technical Requirements - Natural Gas Pipework and Fittings Below Ground**

| <b>POLYETHYLENE PIPES. FUSION JOINTS. BURIED OR EXTERNAL DUCT</b> |                                                |                                                                                                                                        |                                     |                                                                                   |
|-------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------------------------------------------------------------------------|
| <b>WORKING PRESSURE 2 bar.g max</b>                               |                                                |                                                                                                                                        |                                     |                                                                                   |
| <b>ITEM</b>                                                       | <b>NOMINAL SIZE<br/>mm O.D.</b>                | <b>DESCRIPTION</b>                                                                                                                     | <b>BRITISH<br/>STANDARD</b>         | <b>NOTES</b>                                                                      |
| Pipe                                                              | 20mm – 125mm<br><br>180mm -<br>250mm           | Yellow polyethylene pipes.<br>MDPE.<br>Coiled or straight<br>Straight lengths                                                          | 5556: 1978 (1986)<br>7281: 1990     | British Gas<br>standards.<br>BGC/PS/PL.2<br>Part 1                                |
| Heat fusion<br>fittings                                           | 20mm -<br>125mm 90mm<br>- 250mm                | Yellow polyethylene pipes.<br>MDPE.<br>Socket fusion fittings<br>Butt fusion fittings                                                  |                                     | BGC/PS/PL.2<br>Part 2                                                             |
| Mechanical<br>fittings                                            |                                                |                                                                                                                                        |                                     | BGC/PS/PL.3<br>Parts 1 & 2                                                        |
| Flanges                                                           | 63mm -<br><br>125mm<br><br>90mm -<br><br>250mm | MDPE flange adaptors.<br><br>Socket fusion fittings<br><br>Butt fusion fittings<br><br>Each adaptor with PN6 bar<br>loose steel flange | 4504: Part 3:<br>Section 3.3 : 1989 | Protected<br>against<br>corrosion                                                 |
| Isolating<br>valves                                               | 65mm - 250mm                                   | Cast iron body. Ball valve.<br>Trim to suit service<br>conditions. PN6 bar. Flanged                                                    | 5159: 1974 (1991)                   | To be capable of<br>in situ servicing.<br>See Note 3                              |
| Isolating<br>valves                                               |                                                | MDPE type with fusible tails                                                                                                           |                                     | BGC/PS/V7<br>draft                                                                |
| Gaskets at<br>flanges                                             | All sizes metric                               | Flat sheet or corrugated<br>metal ring                                                                                                 | 4865 : 1989                         | Asbestos-free<br>materials but<br>not vulcanised<br>fibre or rubber<br>reinforced |

### Notes:

1. Fusion joints shall be made using electrical tooling and equipment to BGC/PS/PL.2 Part3.
2. Underground pipework shall be laid with a minimum cover of 750mm to finished ground level and shall be laid to a gradient not less than 1:250. Pipework shall be laid on a bed and backfilled to 150mm above the pipe with sand to ensure the pipe wall is not damaged by stones and sharp objects. Thrust blocks complying with the relevant BS Codes of Practice shall be provided at all bends, branches, changes of direction before the installation is tested.

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3. Pipework and fittings shall be kept free from mud, debris, superfluous jointing material during installation, open ends shall be temporarily sealed using purpose made wooden plugs or blank flanges. Where necessary pipework shall be weighted to prevent floatation. All pipes and fittings shall be thoroughly cleaned internally and maintained in a clean condition at all times.

### 4.3 Above Ground Pipework

- 4.3.1 All above ground pipework and fittings shall be mild steel to BS 1387 'Medium'.
- 4.3.2 The installation shall satisfy the requirements of Clause 2.13, 2.15 and 2.16.
- 4.3.3 Threaded joints shall not under any circumstances be formed using PTFE tape.
- 4.3.4 Mild steel pipework and fittings shall be in accordance with the following Schedule of Technical Requirements Table 5.

**Table 5 - Schedule of Technical Requirements - Natural Gas Pipework and Fittings Above Ground**

| CARBON STEEL PIPES. SCREWED, FLANGED OR WELDED JOINTS |                         |                                                 |                                                                                                             |                                            |
|-------------------------------------------------------|-------------------------|-------------------------------------------------|-------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| WORKING PRESSURE 5 bar.g max                          |                         |                                                 | TEMPERATURE - AMBIENT                                                                                       |                                            |
| ITEM                                                  | NOMINAL SIZE            | DESCRIPTION                                     | BRITISH STANDARD                                                                                            | NOTES                                      |
| Pipe                                                  | 15mm to 50mm            | Screwed BS 21 1985                              | 1387                                                                                                        | Medium                                     |
| Pipe                                                  | 65mm to 125mm           | Plain ends                                      | 1387 1985 (1990)                                                                                            | Medium                                     |
| Pipe                                                  | 150mm<br>200mm<br>250mm | Plain ends<br>Plain ends<br>Plain ends          | 3600 1976<br>(1988) Table 1<br>(Hot finished seamless<br>"steel ) 360" to 3601<br>1987 (1993) See Note<br>2 | 5.4mm thick<br>6.3mm thick<br>7.1mm thick  |
| Fittings                                              | 65mm to 250mm           | Carbon steel butt welding fittings              | 1965 1963 (1983)                                                                                            | Thickness to suit pipe                     |
|                                                       | 15mm to 50mm            | Malleable iron Reinforced pattern Screwed BS 21 | 143 & 1256 : 1986                                                                                           |                                            |
| Steel flanges                                         | 15mm to 50mm            | Screwed boss type                               | 4504 Part 3                                                                                                 | BS 21 thread                               |
|                                                       | 65mm to 250mm           | Slip-on boss type<br>Flanges PN10 bar           | 4504 Part 3                                                                                                 | Welded on                                  |
| Gaskets at flanges                                    | All sizes metric        | Flat sheet or corrugated metal ring             | 4865 : 1989                                                                                                 | Asbestos-free materials but not vulcanised |

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|  |  |  |  |                               |    |
|--|--|--|--|-------------------------------|----|
|  |  |  |  | fibre<br>rubber<br>reinforced | or |
|--|--|--|--|-------------------------------|----|

### Notes:

1. Where grade "360" steel is not readily available then grade "410" shall be used.
2. Upon completion all above ground pipework shall be painted with an undercoat and two coats of gloss paint to an approved colour to ensure it is easily identifiable as required by Health & Safety Regulations. Identification shall be in accordance with BS 1710 and shall be identified with the words Natural Gas or CH<sub>4</sub>.
3. Where pipework is located in a builders duct the duct shall be permanently ventilated to outside air in accordance with IGE/UP/2 and the Gas Safety Regulations.

### 4.4 Valves

- 4.4.1 Valves shall be installed in pipelines for the purpose of isolation and they shall be screwed ends up to and including 50mm dia and flanged ends when 65mm and over. An isolating valve shall be installed on the pipework connection to each gas burning appliance and where shown upon the drawings.
- 4.4.2 Valves shall comply with the appropriate British Standard and have a pressure rating appropriate for the installation.
- 4.4.3 Valves up to 50mm dia shall be Crane D191 PN25, BS 5750 copper alloy ball valves threaded to BS 21.
- 4.4.4 Valves 65mm dia and over shall be Crane F614 GEM to BS 5750 lugged water butterfly valves flanged to BS 4504.
- 4.4.5 Gas solenoid valves shall as detailed in Section 3 of the Specification. All valves shall be tested and certified by British Gas.

### 4.5 Pipework Purging

- 4.5.1 Purging points shall be installed in pipelines at each side of isolating valves and in appropriate positions to ensure the whole system can be safety tested and purged. Purge points shall be capped or plugged and shall incorporate a valve to control its operation.
- 4.5.2 Purging of pipelines shall be carried out strictly in accordance with IGE/UP/1 'Soundness Testing and Purging of Industrial and Commercial Gas Installations'.

### 4.6 Safety Precautions

- 4.6.1 The Contractor shall ensure the purging and testing of the gas installation is completed in a workmanlike and safe manner. He shall ensure the works are carried out in compliance with the Health & Safety at Work Act 1 the Gas Safety (Installation and Use) Regulations 1994, the CDM Regulations and the CITB Industrial Gas Safety study notes

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**PART 5 CHILLED WATER INSTALLATIONS**

**NOT USED**

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### PART 6 AIR CONDITIONING AND VENTILATION SYSTEMS

#### 6.1 General

6.1.1 The installation shall conform to all relevant British Standards and Codes of Practice which are current at the time of installation. The Contractors attention is particularly drawn to the following:

|                  |   |                                                                                                        |
|------------------|---|--------------------------------------------------------------------------------------------------------|
| BS 2852          | - | Testing for rating of room air conditioners.                                                           |
| BS 4718          | - | Methods of testing for silencers for air distribution systems.                                         |
| BS 4856          | - | Methods for testing and rating fan coil units, unit heater and unit cooler                             |
| BS 4857          | - | Methods for testing and rating terminal reheat unit distribution systems                               |
| BS 4954          | - | Methods for testing and rating induction units for air distribution-                                   |
| BS ***           | - | Specification for rating and testing unit air conditioners of above 7 kW cooling capacity              |
| BS 5588          | - | Code of Practice for ventilation and air conditioning ductwork                                         |
| BS 6583          | - | Methods for volumetric testing for rating of fan sections in central station air handling units        |
| BS 6821.         | - | Methods for aerodynamic testing of dampers and valves                                                  |
| BS 6901.         | - | Specification for rating and performance of air source heat pumps with electrically driven compressors |
| BS EN 60335-2-40 | - | Electric heat pumps air conditioners and dehumidifiers                                                 |
| BS EN 60335-2-65 | - | Air cleaning appliances                                                                                |

#### 6.2 Ductwork

6.2.1 The Contractor shall provide and fix a complete range of supply, recirculation and extract ductwork together with all necessary fittings and accessories as described below.

6.2.2 All ductwork, fittings and accessories shall be manufactured from hot-dip zinc coated and iron zinc ally coated mild steel sheet and plate in accordance with BS EN 10143:1993.

6.2.3 All ductwork fittings and accessories shall be manufactured and installed in accordance with HVCA Specification for sheet Metal Ductwork DW/144. The pressure and leakage classification for the ductwork system shall be identified elsewhere in this Specification.

6.2.4 Where kitchen ventilation systems are required ductwork, fittings and accessories shall be manufactured and installed in accordance with DW/171 guide to good practice for kitchen ventilation systems.

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- 6.2.5 The ductwork system shall be maintained throughout the installation period in a clean condition and shall finally be cleaned prior to testing in accordance with DW/TM2 guide to good practice - internal cleanliness of new ductwork installations.
- 6.2.6 Efficient protection shall be given to all duct ends left disconnected during the progress of the works.
- 6.2.7 Protection shall be carried out by using heavy grade polythene taped in position or other approved method. The Contractor shall ensure that all necessary test holes and holes required for thermostat and thermometer bulbs are provided in the ducts and shall ensure that any defects in the galvanised coating are painted with galvafruid paint.
- 6.2.8 The ductwork shall be complete with dampers, bends, tees, tapers, transformation and special pieces. Lobster back type bends or mitred type elbows will NOT be permitted under any circumstances.
- 6.2.9 All positions for plant and ductwork shall be checked on site and detailed installation drawings shall be submitted to the Engineers before manufacture is commenced.
- 6.2.10 Transformation or taper pieces shall be constructed so that the angle on any side does not exceed 20 degrees to the axis of the duct. Sharp corners or edges on ductwork, associated equipment, supports and angle supports, shall not be allowed.
- 6.2.11 All flanged joints shall be provided with a 3mm thick full faced rubber gasket, where slip joints occur, they shall be telescoped to ensure a tight taper fit, have an overlap of not less than 75mm and sealed over the full lap not greater than 50mm.
- 6.2.12 The Contractor shall ensure that all bends have a throat radius of at least half the width of the duct, bends fitted with guide vanes shall be used where indicated upon the drawings.
- 6.2.13 Control dampers shall be provided where indicated upon the drawings and these shall be of the streamlined multi-leaf type, the spindles of which shall be fixed to quadrants. The damper blades shall be fixed in line with the operating arm of the quadrant and 'open' and 'closed' plates.
- 6.2.14 Control dampers not exceeding 300mm wide and 300mm deep shall be of the single leaf pattern.
- 6.2.15 Control dampers above this size shall be of the double skin multi-louvred pattern with a maximum blade width of 250mm.
- 6.2.16 The connections to all items of plant shall be made with acoustic type flexible connectors.
- 6.2.17 All supports and brackets shall be felt lined and painted ONE COAT of red oxide before and after erecting. All nuts and bolts shall be sheradised. The fastening of electrical cables to ductwork will NOT be permitted.
- 6.2.18 Ductwork where passing through floors, walls, roofs, etc. shall be provided with galvanised steel sleeves packed with manual fibre or similar non-flammable fire resisting material form a

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fire/smoke stop of adequate rating and to eliminate movement of air between the duct and the sleeve and the transmission of noise from one area to another.

- 6.2.19 Ducts shall not come into contact with the fabric of the building except where fire/smoke dampers are fitted in the building fabric.
- 6.2.20 Expansion joints shall be provided on all straight runs of ductwork exceeding 21m. Hangers and brackets for ductwork shall be spaced to ensure adequate support and where practicable shall be fitted at each joint of the ductwork.
- 6.2.21 The whole of the ductwork shall be cleaned by means of a high vacuum plant supplied by the Contractor immediately prior to the operation of each installation.
- 6.2.22 Test points shall be included at each side of items of equipment, upstream of dampers and as required to measure the system performance.
- 6.2.23 Upon completion of the ductwork installation, the Contractor shall be required to demonstrate to the Engineer that the system is air tight by carrying out air leakage test in accordance with DW/143 where appropriate.
- 6.2.24 The ductwork shall be manufactured by a Specialist Ductwork Contractor approved by the Engineer and the Contractor shall demonstrate the quality of workmanship to the Engineer if required before approval is given.

### 6.3 Fire Dampers

- 6.3.1 The Contractor shall provide and fix in the positions indicated upon the drawings and as detailed in Section 3 fire/smoke dampers.
- 6.3.2 Fire dampers shall be mounted within the ducts shown and the shutter shall be located such that it is positioned within the extremities of the fire wall, floor, blanket etc.
- 6.3.3 All fire dampers shall be designed to give a fire resistance of two hours when tested, in accordance with BS 476: Part 24 and shall comply with DW/TM3 guide to good practice for the design and installation of fire and smoke dampers.
- 6.3.4 Fire dampers shall be located horizontally, or vertically, as required and the Contractor shall ensure they are installed in accordance with the local Fire Officer's requirements.

### 6.4 Duct Access Doors

- 6.4.1 The Contractor shall supply and fix duct access doors to ductwork at intervals not exceeding 3m for cleaning and at the following positions:
  - 1. At each side of all heating and cooling coils for the purpose of inspecting and cleaning the coils.
  - 2. At each side of all filters.
  - 3. At each side of all attenuators.
  - 4. At one side of all dampers.

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- 5. At one side of all fire dampers.
- 6. As required by Table 25 of DW/144.
- 6.4.2 Access doors shall be rectangular double skin sandwich construction lift-off doors.
- 6.5 Flexible Ductwork**
  - 6.5.1 The Contractor shall provide and fix ranges of flexible ductwork as shown upon the drawings. The size of ductwork shall be shown upon the drawings or detailed in the Schedule of Grilles and Diffusers. Flexible ductwork shall be used to connect trunk ducts to grilles using the shortest length possible commensurate with providing the required degree of tolerance required for the system installation. Flexible ductwork shall not be installed with a tight radius bend thus preventing puckering occurring and shall be independently bracketed to prevent undue sagging.
  - 6.5.2 Connections shall be made to all items of equipment using a good quality jubilee clip. All joints shall be air tight and shall be finally taped with heat resisting 50mm wide PVC adhesive tape which shall also be used to seal the insulation to the ends of each length of ductwork.
  - 6.5.3 Flexible ductwork shall be as follows:
    - Supply (Conditioned) Air -Type M-KC pre-insulated
    - Recirculation/Extract -Type ST
  - 6.5.4 All flexible ductwork shall be Thermaflex as manufactured Flexible Ducting Limited, Milngavie, Glasgow, G62 7LW or equal and approved.
- 6.6 Grilles and Diffusers**
  - 6.6.1 The Contractor shall provide and fix in the positions indicated upon the drawings, diffusers and transfer grilles.
  - 6.6.2 The grilles and diffusers shall be constructed from polished extruded aluminium complete with standard fixings, as recommended by the manufacturers, or of the type detailed later and finished with a stone enamel finish to our approved BS colour.
  - 6.6.3 All grilles and diffusers shall be in accordance with the details described in the Schedule of Grilles and Diffusers.
  - 6.6.4 The frame and fixing details shall be selected to ensure compatibility with the suspended ceiling, they shall be complete with plenum boxes as required and shall be supported from the structure with mild steel drop rods. All drop rods shall be cut back and fitted with plastic end caps.

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### 6.7 Air Handling Units

6.7.1 Supply, provide and fix air handling units as described below, in the schedules and as shown on the drawings.

a) General Requirements

- External noise (maximum) - NC<sub>50</sub> at 3.0m Internal noise (maximum) - NC<sub>40</sub>.
- Units shall be suitable for an internal or external (weatherproof) location as detailed in Section 3 of the Specification.
- Unit sections shall be designed and constructed to prevent drumming or distortion of panels up to a pressure differential of 2500 Pa.
- Each unit shall be of modular construction for ease of handling and replacement or addition of sections.
- Each section shall have matching cross sectional dimensions, be of the same construction type and present a clean internal appearance to ensure even airflow through the components.
- Steel channel bases shall be provided under all units. These shall be 150mm high or 200mm as specified.
- Prior to dispatch, each section shall be shrink wrapped, using heavy gauge polythene sheeting to provide protection during shipment and installation.
- The Contractor shall ensure that the units are adequately protected throughout the contract. Access doors shall be provided to ensure ease of access for maintenance cleaning and repair. The acoustic performance of the air handling unit shall be as specified in Section 3.
- The Engineer reserves the right to have any panels which are scratched or otherwise damaged, replaced at the Contractor's expense.

b) Basic Construction

- The unit shall be of framed construction. The frame shall be built from Modar composite material providing high thermal, high strength, corrosion free and fire resistant properties.
- Frame members shall be bonded/mechanically fixed together to provide strength equal to welding and to prevent air leakage.
- Panels shall be flush mounted into the unit framework. They shall be 50mm thick double-skinned insulated construction, with a Colorcoat Plastisol pre-coated steel outer skin to provide a tough surface finish. The panel inner skin shall be formed from pre-galvanised steel.

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- Panels shall have a CFC free rigid foam insulation infill with a thermal conductivity no greater than 0.02 W/m°C. Insertion loss through the panels shall be sufficient to achieve 25dB and 27dB reductions at 63 and 125 Hz octave bands respectively.
- All panels shall be removable, being retained by flush headed screws which do not penetrate through the framework. Access doors shall be provided with heavy duty hinges and cam handles.
- The floor of the unit shall be flush, with no lips at doors or access panels, so that sections can be sluiced out.
- The design of the unit shall be free from cold bridges. There shall be no direct metallic contact between the inside and the outside of the cabinets due to the non-conducting properties of the frame, the design of the panels and the design of the fixings and fasteners.
- Air leakage of the assembled units shall be to DW/144 Class B.
- Frames shall be self-coloured to BS 4800. Panels externally shall be from the BSC Colorcoat standard range.

### c) Fan Section

- Fans shall be double inlet, double width, centrifugal construction pedestal bearing type with forward or backward curved impellers with a total efficiency of not less than 75%.
- Vibration isolation shall be by springs. Rubber mountings shall not be used. Scrolls shall be fabricated from galvanised steel, seam jointed to give strength and eliminate leakage. The inlets shall be fitted with aerodynamically designed volutes.
- Shafts shall be manufactured from accurately turned and ground steel, keywayed at both ends. The bearings shall be sealed for life ball bearings in rubber anti-vibration housing or split plummer blocks with self-aligning ball bearings as applicable. A flexible connection shall isolate the fan casing from the unit casing, this shall also be fire resistant.
- Impellers shall be dynamically balanced at their rated speed to BS 6861: Part 1 1987.
- The fans shall be driven by Totally Enclosed Fan Ventilated Motors. All motors shall be suitable for 415V, 3 phase/240, 1 phase 50 Hertz electrical supply as required and shall have Class F insulation rated for Class B temperature rise.
- The motor frame size shall be 110% of the rated duty.

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- Fan drives shall be multi-vee pulleys fixed to the fan and motor shafts by means of taper lock bushes. Matched sets of Vee belts shall be supplied to provide the required fan speed. Drive guards shall be removable to provide access for maintenance.
- Where top discharge is required fans shall be positioned so that the throw of the air follows the ductwork bend immediately after the discharge to reduce friction losses.

### d) Heating and Cooling Coils

- Coils shall be manufactured from solid drawn seamless copper tubes staggered in the direction of airflow. Tube return bends shall be copper, brazed to the tube ends. Tubes shall be expanded to permanently bond them to the fins.
- Fins shall be manufactured from pre-tinned copper, having extended collars for spacing and shall be bonded mechanically to the tube. Headers shall be heavy gauge seamless copper tube. The casing shall be galvanised mild steel on the heating coils and brass on all cooling coils and extract run around coils.
- Coils shall be air pressure tested under water to 21 bar after manufacture.
- Coil sections shall be arranged to provide removal of coils from the access side of the section. Coils shall be horizontally split where necessary, with same side pipework connections.
- Drain pans shall be incorporated inside all cooling coil sections and shall extend underneath the headers and beyond the fin block to ensure adequate collection of condensate. They shall be of sloping design. On stacked coils, intermediate drain troughs shall be fitted. Drain pans shall be manufactured from galvanised steel which shall be coated with an epoxy paint system for added protection.
- Plastic eliminators shall be utilised only at the discretion of the manufacturer. Traps on cooling coils shall be clear borosilicate glass to prove the integrity of the water seal. The trap depth shall be not less than 1.5 times the fan static pressure.
- Each trap shall incorporate quick release couplings to enable easy removal of the traps, and a water fill point. Condensate pipework shall be routed in copper to BS 1387 to the plant room drain.

### e) Mixing Box

- The mixing box shall be fitted with opposed blade aerofoil section dampers and shall be selected and sized with authority to give near linear performance.
- The blades shall be roll formed from two aluminium strips to form torsionally rigid hollow profile sections with lock seams for high strength.

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- The aerofoil section shall provide low air resistance and low noise generation. Standard bearings shall be low friction nylon which require no maintenance in operation. Each shaft shall be fitted with an external cover to prevent air leakage.
- Coupling of the blades shall be by means of internally mounted, high precision aluminium gears to ensure positive accurate movement with minimum actuating force.

### f) Filters

- The filters shall be mounted within a 'Polyseal' side access arrangement enabling filter replacement to be from the side. The side access arrangement shall consist of extruded aluminium tracks which shall be fitted with a lipped, moulded gasket which inflates under the air pressure to provide an effective seal. The ends of the filter mounting tracks shall be sealed with gasketed metal inserts to prevent air bypass. All filters shall be flame resistant.
- Filters performance shall be as detailed in Section 3.
- The Contractor shall demonstrate to the Engineers that suitable access is provided to remove and install filter panels.
- The tracking shall incorporate channels for fitting pre-filters, so forming a compact assembly. Only standard sized filters shall be used.

### g) Notes

An allowance shall be included for the changing of pulleys and belts (once only) at commissioning stage.

1. Each unit shall have an inclined manometer fitted across each filter with indicators showing clean and dirty conditions.

The sections of the air handling unit shall be bolted to the channel base by the manufacturer. Each unit shall be assembled on site in the plant room and the Contractor shall include for the manufacturer's representative to visit the site (1 visit per unit) to check that the unit is correctly assembled.

The unit shall be complete with holes cut through the double skinned sections by the manufacturer to accept the various thermostats, thermometers, sensors and controls shown on the drawings as listed in the Automatic Controls Specification.

The holes shall be suitably sealed to prevent migration of the insulation in the panels. All coils shall be easily removable for maintenance purposes.

All materials incorporated in the construction of the unit shall not support micro biological growth; this applies particularly to mastics, gaskets, insulation etc.

2. Each unit shall come complete with an initial fill of bag filter media, along with a complete set of spare drive belts and pulleys.

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Each unit shall be delivered in two or more sections to facilitate

3. Each unit shall be delivered in two or more sections to facilitate installation and shall be assembled on site within the plant room.

The Contractor shall be responsible for determining the number of sections required prior to ordering. Claims arising from failure to do so shall not be considered.

4. The air handling unit motorised dampers shall be set to work so that upon commencement of operation the damper shall open to a pre-set/commissioned point and upon unit shut down (after the pre-set fan run on time) the dampers shall close fully to outside air to avoid back draughts.

5. Air handling unit sections shall be of a horizontal or banked configuration as detailed in Section

The Mechanical Services Contractor shall allow for all necessary supports as dictated by the manufacturer and the unit shall be designed to sit on a concrete plinth as detailed by the Structural Engineer. Vibration isolation springs shall be positioned between the unit and the base as detailed in 3.4.8.

6. Each air handling unit shall be commissioned to the required airvolume.
7. The fans shall be turned manually by the Contractor on a weekly basis for the duration of the installation to avoid bearing damage and suitable certification supplied.

### 6.8 Extract Fans

- 6.8.1 The Contractor shall supply, install and commission extract fans and ancillaries as shown on the drawings and specified in Section B.

### 6.9 Silencers

- 6.9.1 The Contractor shall provide and fix silencers as detailed in the schedules and described below.
- 6.9.2 Silencers shall be suitable for the temperature and quality of air being handled, constructed to DW/144 Specification for low/medium pressure ductwork and type tested to BS 4718 at the manufacturer's works or an approved testing laboratory, and certificates provided.
- 6.9.3 Silencers shall have an outer casing of not less than 0.8mm gauge galvanised sheet steel. Longitudinal joints shall be lock formed and mastic sealed. Each connection shall be drilled angle iron Doby flanges to the casing with huckbolts with the casing peened back over the flanges, or extended spigot fixing as detailed in the schedules. The direction of airflow shall be clearly marked on the casing.
- 6.9.4 The infill shall be in organic mineral wool or sufficient density to obtain the specified acoustic performance and packed at not less than 5% compression to eliminate voids due to settling.

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The fibrous infill shall be non-shedding, non-combustible, non-hygroscopic, vermin proof and chemically inert.

- 6.9.5 Silencers shall be lined with melinex or equal material to prevent the absorption of moisture, dirt and corrosive substances and the release of fibrous particles.
- 6.9.6 Sound absorbent elements shall have aerodynamic fairings on air entry and exit end of silencer.

### 6.10 Vibration Isolation Springs

- 6.10.1 The air handling unit shall be isolated from the structure using constant level anti-vibration spring mountings.
- 6.10.2 The Contractor shall supply and fix the mountings at the positions identified by the air handling unit manufacturer and shall be responsible for obtaining this information at tender stage.
- 6.10.3 The spring mounts shall be free standing, laterally stable without housings, snubbers or guards and complete with a 5mm thick ribbed acoustical neoprene pad, cold bonded to the underside of the box plate.
- 6.10.4 Each mounting shall comprise of a polyester coated high frequency isolation pad, spring pressure plate and high deflection colour coded steel spring. Flexible connections shall be utilised to connect the ventilation ductwork to the air handling unit.

### 6.11 Refrigerant Pipework Installation

- 6.11.1 The air conditioning systems indoor and outdoor units shall be interconnected by means of refrigerant quality copper tubing to BS 2871, Part 2. Pipework sizes ¼" and ½" shall be supplied as coils. Pipework above this size shall be supplied as rigid lengths. All required branches, tees and joints necessary for the satisfactory completion of the works shall be provided.
- 6.11.2 Joints shall be kept to a minimum and bronze connections used where necessary complying to BS 1723. The refrigerant and condensate pipework shall be supported on medium gauge galvanised steel cable tray using 17mm EVA coated galvanised steel cable band straps fixed by proprietary screw fixings. Larger bore pipework shall be mounted using hydrosorb clips on brackets at distances specified in Section 2.3.2. The distance between supports and straps shall be as follows:
- 6.11.3 Band straps maximum 1 metre. Tray supports maximum 2 metres.
- 6.11.4 Mitre bends and tees in the cable tray shall be formed by cutting the tray and removing any sharp edges. Support drop rods shall be cut back to 25mm and fitted with plastic caps.
- 6.11.5 A leak test shall not be conducted until the pressure test is satisfactorily completed and the leak test shall be carried out with Nitrogen or any other inert gas.

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- 6.11.6 The leak test pressure shall be held for at least one hour. Any fall in pressure, after due allowance for ambient temperature change, indicates a leak which should be traced. If any leaks are present, the fault shall be corrected, and the system shall be retested. Repairs, particularly involving brazing, shall not be carried out on any part of the system or component whilst under pressure.
- 6.11.7 The system shall be evacuated to 2mm Hg. to eliminate any moisture which may be present in the system. After completion, the system shall be ready for the correct charge of R407C refrigerant and the refrigeration duty oil.
- 6.11.8 All pipework (including copper condensate drains) above ½" nb.) shall be insulated using 20mm thick Class 'O' finish Armaflex fixed in accordance with the manufacturer's instructions. All pipework up to ½" nb. shall be insulated using 12mm Armaflex. All external and exposed pipework shall be finally finished with two coats of 'Armafinish' paint.
- 6.11.9 Pumped condensate drains following the route of the refrigerant pipework shall be installed using suitable seamless PVC braided tube. Joints shall not be allowed. The condensate pipework shall be supported as the refrigerant pipework on the cable tray. The Contractor shall ensure that the drain is not constricted at any point.
- 6.11.10 Where the condensate header enters the main drainage stack, it shall be connected via a suitable deep seal trap and tundish arrangement to the approval of the Consulting Engineers.
- 6.11.11 The Contractor shall include for Hydron or Peristaltic condensate pumps as indicated on the drawings or in the Particular Specification. The pumps shall be of the sump type where practicable and be complete with a failsafe device which shall, in the case of pump failure, switch off the applicable units. The condensate pumps shall be wired to the unit by the refrigerant Contractor and shall be fixed to the unit or adjacent structure as applicable, with suitable provision made to avoid vibration. The condensate pipework shall be connected to the pump discharge port using a proprietary spring clip.
- 6.11.12 The Contractor shall include for the recovery of any refrigerant when plant is "Blown Down". This recovered refrigerant shall be returned to the relevant refrigeration supplier.
- 6.11.13 The refrigerant pipework design shall be carried out in accordance with the requirements dictated by the manufacturers within their technical manuals or advised by the distributor. Refrigeration pipework shall be installed in standard sizes stipulated within the manufacturer's standard Technical Specification.
- 6.11.14 Refrigeration pipework shall be labelled generally as follows:
- R407C Gas Line
  - R407V Liquid Line.
- 6.11.15 The whole of the installation shall be carried out by an approved accredited refrigeration company.

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### 6.12 Split System Unitary Air Conditioning Units

- 6.12.1 The Contractor shall provide and fix in the positions indicated upon the drawings and as detailed in Section B Split System Unitary Air Conditioning equipment consisting of condensers, Heat Pump Units or Cassette Units. All such equipment shall be installed, commissioned and set to work strictly in accordance with the manufacturer's recommendations. The Contractor shall demonstrate to the Engineer that suitable access is provided to remove and install filter panels.
- 6.12.2 External condensing equipment shall be fully weatherproof, ceiling mounted, or void mounted equipment shall be supported from the structure using mild steel drop rods cut back and fitted with plastic end caps.
- 6.12.3 All unitary equipment shall be fully packaged, complete with an integral control system and factory decorated to an approved colour.
- 6.12.4 Floor mounted units shall be securely fixed to either an adjacent wall or floor as appropriate using proprietary fixings.
- 6.12.5 Condensing units shall be fixed to steel supports using proprietary fixings. Screwed fixings shall not be used.

### 6.13 Painting and Finishing Off the Works

- 6.13.1 All items of plant which are finished painted at the manufacturers works shall be protected as required by this Specification and prior to final completion of the works, these items shall be thoroughly cleaned in a manner which does not damage the paint finish and polished to remove all buildings debris, insulation and paint splashes.
- 6.13.2 After cleaning, if any damage is apparent, the plant shall be touched up or completely repainted to the entire satisfaction of the Engineer.
- 6.13.3 The Contractor shall note that all exposed copper pipework shall be cleaned of jointing compound solder etc. and shall when situated in the plant room be polished and given a coat of clear lacquer.
- 6.13.4 The Contractor shall note that exposed copper pipework outside of the plant room which is not required to be chromium plated shall be cleaned prior to decoration by other trades.

#### IMPORTANT NOTE:

It is the responsibility of the Mechanical Contractor to ensure all items of plant and equipment become operational in a condition equal to that when they left the manufacturers finished assembly line. Damage by other trades will not be accepted as a reason for a sub-standard finish of plant and equipment.

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### PART 7 AUTOMATIC CONTROL SYSTEMS

#### 7.1 General

7.1.1 The installation shall conform to all relevant British Standards and Codes of Practice which are current at the time of installation. The Contractors attention is particularly drawn to the following: -

- |             |                                                                                                              |
|-------------|--------------------------------------------------------------------------------------------------------------|
| BS 1655     | Specification for flanged automatic control valves for the process control industry.                         |
| BS 3955     | Specification for electrical controls for household and similar general purposes.                            |
| BS EN 126   | Multifunction controls for gas burning appliances. BS EN50090 Home and Building electronic systems.          |
| BS EN 60073 | Specification for coding of indicative devices and actuators by colour and supplementary means.              |
| BS EN 60534 | Industrial process control valves.                                                                           |
| BS EN 60546 | Controllers with analogue signals for use in industrial process control system.                              |
| BS EN 60654 | Industrial process measurement and control equipment. Operating condition.                                   |
| BS EN 60730 | Specification for automatic electrical controls for household and similar use.                               |
| BS EN 60947 | Specification for low voltage switchgear and control gear. BS EN 61003 Industrial - process control systems. |
| BS EN 61038 | Specification for time switches for tariff and load control. BS EN 61131 Programmable controller.            |
| DDENV 1805  | Data communication for HVAC Application Management Net.                                                      |

#### 7.2 General Requirements

- 7.2.1 The automatic control systems for the mechanical services shall be based on the use of local intelligent ddc controllers which shall be housed in control panels strategically located within the building. The control panels shall also have motor starters, fuses, switches indicator light, relays, etc. for the control of mechanical items of plant which together make up the mechanical services.
- 7.2.2 Control valves shall be of the magnetically operating seat type with 500:1 turn down ratio and standard manufacturers 5-year guarantee.
- 7.2.3 The Contractor shall be responsible for coordinating the automatic controls specialist.
- 7.2.4 The whole of the automatic controls installation shall be supervised during the installation by the controls manufacturer. Prior to manufacture and installation, the controls manufacturer shall produce detailed drawings of the controls panels which identifies all external terminals for connection by the Electrical Contractor and provides an illustration of the panel facia.

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- 7.2.5 The Contractor shall be responsible for coordinating the automatic controls specialist. The Contractor shall be responsible for confirming all pump/fan motor sizes etc. to the automatic controls specialist.
- 7.2.6 Upon completion the manufacturer shall test and commission the whole of the control installation to the entire satisfaction of the Engineer.
- 7.2.7 The Controls Engineer shall include for the provision of instructing the Client on practical completion with regard to plant operation. A further visit shall be included by the Controls Commissioning Engineer to fully instruct the user of the satisfaction of the Engineer.

### 7.3 Field Mounting Components

- 7.3.1 All field mounting components provided as part of this automatic control system shall be fully compatible and able to operate in conjunction with the range ddc controls which are used throughout the project.
- 7.3.2 All control valves used throughout this project shall be of the magnetically operated seat type to ensure tight closing, with spring return actuator, manual override feature, a turn down ratio of 500:1 and be provided complete with a manufacturer's 5-year guarantee.

### 7.4 Operational Requirements

- 7.4.1 If the building fire alarm system should operate, if a fire detector above a burner should operate, or if the emergency stop button is pressed all plant fed from the control panels shall switch off and the gas solenoid valves shall close. Once this situation has arisen it shall be necessary to press the system reset buttons before the system can return to normal. A test override button shall be provided on the panel front and, if this is pressed, the fire alarm cut out circuitry shall be disabled for fifteen minutes so that the building fire alarms may be tested without switching the HVAC system off.
- 7.4.2 All ventilation plant shall be started and stopped automatically at fixed times under the direction of their own dedicated time switch programmes entered into the ddc control system.
- 7.4.3 When a ventilation plant is switched off its associated motorised dampers shall move to the closed to fresh air position.
- 7.4.4 If the temperature in the ductwork immediately downstream from the heater battery, or frost coil, should fall to near freezing the associated supply and extract fans shall automatically switch off to reduce the possibility of the coils freezing.
- 7.4.5 The extract fans shall automatically switch on and off whenever required to run. Supply fans and overdoor heaters shall not run until the common flow water temperature from the duty constant temperature heating pump has risen to a pre-selected level.

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### PART 8 THERMAL INSULATION

#### 8.1 General

8.1.1 The installation shall conform to all relevant British Standards and Codes of Practice which are current at the time of installation. The Contractors attention is particularly drawn to the following:

- |             |   |                                                                                              |
|-------------|---|----------------------------------------------------------------------------------------------|
| BS 476      | - | Fire test on building materials and structures                                               |
| BS 874      | - | Methods of determining thermal properties, with definitions of thermal insulating terms      |
| BS 1710     | - | Specification for identification of pipelines and services                                   |
| BS 3533     | - | Glossary of terms relating to thermal insulation                                             |
| BS 5422     | - | The use of thermal insulating materials                                                      |
| BS 3958     | - | Thermal insulating materials                                                                 |
| BS EN 14314 | - | Thermal Insulation for building equipment and industrial installations Phenolic Foam         |
| BS 4508     | - | Thermally insulated underground piping systems                                               |
| BS 5970     | - | Thermal insulation of pipework and equipment in the temperature range of - 100°C to + 870°C. |
| BS EN 13941 | - | Design and installation of pre-insulated bonded pipe systems for district heating            |

8.1.2 Insulating materials and finishes shall be completely free of asbestos.

8.1.3 All materials shall have a Class 'O' fire rating to the current edition of the Building Regulations, when tested to BS 476 Parts 6 and 7.

8.1.4 All thermal insulation materials shall have a Specific Optical Density less than 5 when exposed to an irradiance of 25 kW/m<sup>2</sup> and less than 15 when exposed to an irradiance of 50 kW/m<sup>2</sup> in accordance with BS 5659-2 (note: BS 5111-1 Status : Superseded, Withdrawn Replaced By : BS ISO 5659-2.)

8.1.5 To ensure that the correct thickness and Specification of insulation has been applied, one section of each type of insulation shall be cut out for inspection. If the insulation reveals defects a further two sections shall be cut out for inspection. If these prove defective the whole of the insulation shall be removed and new insulation and finishes, as specified, applied at the Contractor's expense.

8.1.6 Particular attention shall be given to the finished appearance of all thermal insulation which must present a neat and symmetrical appearance running true in line with pipe layouts. Any rough, irregular or badly finished insulation at surfaces, bends, tees and supports shall be

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stripped down and re- insulated at the Contractor's expense. Allowance for expansion and contraction of insulation shall be made in accordance with the manufacturer's recommendations.

- 8.1.7 Where instrument points, tappings, name plates, plant instructions, etc. are provided in the installation, the insulation shall be cut away and the edges neatly finished and sealed.
- 8.1.8 Pipework or ductwork shall be insulated separately, and adjacent parallel pipes shall not be married together in one common insulation covering.
- 8.1.9 Insulation shall be neatly squared off at all insulated separated or uninsulated obstructions in pipework and ductwork allowing for expansion, contraction, easy access and disconnection of removable items without the disturbance of the surrounding insulation. All squared off ends shall be covered with purpose made end caps, which match the insulation outer covering.
- 8.1.10 Vapour barriers incorporated in insulation shall be continuous. The removable portions of the insulation to access doors, flanged joints, manholes, etc. shall be fitted as separate items with their vapour barrier overlapping and sealed to the main vapour barrier.
- 8.1.11 8.1.11 External weatherproof insulation shall be continuous and shall not be punctured by supports, special care being paid to sealing of the insulation at access doors, manholes, valves, flanges, expansion joints and anchor points to prevent ingress of water. The external finish shall be perforated with 6mm diameter holes at 150mm centres on the underside.
- 8.1.12 Components such as bolted ends, manholes, access doors, removable chests on vessels, valve bodies, flanges, pipe guides, anchor points and expansion bellows shall be insulated.
- 8.1.13 All insulating materials shall be installed in accordance with the manufacturer's recommendations. All adhesives used shall be fire resistant.
- 8.1.14 Before applying any type of insulating material over copper pipework the following procedure should be carried out in order to reduce the risk of pinhole corrosion which can be caused by corrosive elements sometimes present in water and in the dust from building site materials.
1. Completely wipe clean the surface of the copper pipe remove all traces of moisture and dust.
  2. Smear on to the surface of the copper a thin coating of anti-corrosive gel, such as Denso paste or equivalent.
  3. Proceed to fit the insulating material in the normal manner.
- 8.1.15 Where electric trace heating is fitted to pipework oversized pre-formed sections of insulation shall be provided to accommodate the thickness of the trace heating cable.

### 8.2 Service to be Insulated

- 8.2.1 Insulation shall be applied to the following services:

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- 8.2.2 LPHW heating and chilled water pipework, but excluding any pipework located and designed to contribute heat to the space.
- 8.2.3 Hot and cold service pipework but excluding final connections to draw off points in domestic locations. Pipework and vessels in a DX refrigeration system.
- 8.2.4 Intake ductwork to plant.
- 8.2.5 Ductwork carrying heated, cooled, tempered or conditioned supply air.
- 8.2.6 Cold feed and open vent pipework.
- 8.2.7 All water storage vessels and calorifiers.

### 8.3 Insulation of Materials

- 8.3.1 The following insulation materials are available for use within buildings except where their use is restricted under Sub Section 5.4.
- 8.3.2 Rigid phenolic foam pipe insulation, FM approved, with a nominal density of 35kg/m<sup>3</sup> and a thermal conductivity value not exceeding 0.025 W/mK at mean temperature 100C. Bore face all sections to be de-dusted and coated with a non-odorous passivating solution. All sections to be supplied with a fully bonded reinforced aluminium foil facing.
- 8.3.3 Rigid phenolic foam laminate, FM approved, with a nominal density 40kg/m<sup>3</sup> and a thermal conductivity value not exceeding 0.022 W/mK at mean temperature 100C. Laminate to have reinforced aluminium foil bonded to one face.
- 8.3.4 Phenolic foam laminate as above but back slotted to accommodate curvature on circular ductwork.
- 8.3.5 Mineral wool pipe insulation resin bonded with a minimum density of 80kg/m<sup>3</sup> for rock fibre. Thermal conductivity value shall not exceed 0.043 W/mK at mean temperature 1000C.
- 8.3.6 Mineral wool duct insulation resin bonded in a range of densities from 35kg/m<sup>3</sup> to 100kg/m<sup>3</sup> dependant on location. Thermal conductivity value shall not exceed 0.043 W/mK at mean temperature 1000C.

### 8.4 Material Restrictions

- 8.4.1 Phenolic foam insulation shall not be used on pipework or equipment operating at temperatures above 1100C.
- 8.4.2 Insulation materials containing glass or rock fibre shall not be installed in kitchens, food preparation or food storage areas (including ceiling voids and ducts and access from these areas) nor in air-conditioned spaces.
- 8.4.3 Hygroscopic insulation materials shall not be installed in areas subject to weather exposure or in external ground ducts subject to flooding.

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### 8.5 Installation Requirements

- 8.5.1 The Contractor shall ensure that the correct thickness, thermal conductivity, fire rating and density of insulation meet the requirements of this Specification.
- 8.5.2 Where insulation is not required at valves, flanges or supports it shall be finished 50mm short of the fitting, squared off and the end covered with a purpose made cap.
- 8.5.3 All work shall be left perfectly smooth, clean and properly finished. Any poor quality work shall be stripped and replaced at the Contractor's expense and to the satisfaction of the Engineer.
- 8.5.4 All unused insulation finishes, and packaging shall be removed from the site before the final acceptance of the work.

### 8.6 Pipework

- 8.6.1 Pipework shall be insulated with foil faced rigid sections to the thicknesses tabulated in the appropriate table, it shall be secured by means of circumferential bands of non-ferrous metal or 50mm wide self-adhesive aluminium foil tape at maximum 300mm centres.
- 8.6.2 The foil facing to insulation on mains cold water services, chilled water and other pipes carrying liquid at or below the dew point shall have circumferential and longitudinal joints sealed with 50mm wide self-adhesive aluminium foil tape to complete with vapour barrier.
- 8.6.3 All ends of the insulation at entry to valve or flanged boxes and points where the covering is penetrated shall be sealed so that the continuity of the vapour barrier is maintained.
- 8.6.4 Where pipework or other services are used externally to buildings increase insulation thicknesses by one standard size or as indicated.

### 8.7 Ductwork

- 8.7.1 Thermal insulation shall be applied to supply ductwork throughout the installation, fresh air intake ductwork, extract and recirculation in plant rooms.
- 8.7.2 Insulation shall be fixed with a minimum of direct metal paths which thermally bridge the insulation, particularly when the insulation is metal faced. Ensure that thermal insulation covers all flanged joints, fasteners and stiffeners, either by means of purpose made boxes or by increasing the general thickness of the insulation to give at least 6mm cover.
- 8.7.3 Apply foil faced/resin bonded insulation slab to all faces with adjacent sides lapped to maintain a uniform thickness at corners.
- 8.7.4 The insulation shall be bonded on all sides with a fire-resistant contact adhesive, on inverted surfaces or where the sides of the ducting exceeds 600mm, the adhesive shall be used in combination with mechanical support comprising rust proof metal studs or plastic studs bonded to the duct surface. Insulation shall be impaled onto the stud and secured with washers.

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- 8.7.5 All joints in the foil facing or protrusions through the facing are to be sealed with 100mm wide self- adhesive aluminium foil tape.

### 8.8 Insulation of Supports

- 8.8.1 On pipework conveying liquids or gases at temperatures lower than 1000C the pipe shall be isolated from supporting clips, props or struts by fitting high density phenolic foam inserts. These shall be purpose made blocks 100/125mm long, with bonded spreader plate and with factory applied reinforced aluminium foil facing.
- 8.8.2 On pipework conveying liquids or gases at temperatures above 1000C the pipe shall be isolated from supporting clips, props or struts by fitting high density water resistant vermiculite inserts.
- 8.8.3 The inserts shall be purpose made blocks with aluminium foil facing.
- 8.8.4 On ductwork conveying conditioned air the duct shall be isolated from supporting struts by fitting foil faced high density phenolic foam strip 150mm wide x the full duct width and to match the thickness of adjacent insulation.

### 8.9 Valve and Flange Boxes

- 8.9.1 All valves and flanges operating at or above 1000C shall be enclosed in removable insulated boxes. The boxes are to be fabricated from 0.91mm thick stucco embossed aluminium sheeting and be in the form of two sections, hinged on one side and secured on the other side with two quick release toggle fasteners of the spring shackle lock type.
- 8.9.2 Boxes shall be internally lined with mineral wool slab/section or mattress to the same thickness as insulation on adjacent pipework.
- 8.9.3 Outside of plant rooms or away from viewable areas, metal boxes shall be omitted, and the fittings will be insulated with prefabricated faced mattresses filled with mineral wool and secured with hooks and malleable copper binding wire or 'velcro' straps.
- 8.9.4 All valves and flanges operating at temperatures below 1000C shall be enclosed in removable insulated boxes as described above, except that the insulation shall comprise 35kg/m<sup>3</sup> CFC and HCFC free rigid phenolic foam insulation in place of mineral wool.
- 8.9.5 On pipework operating at temperatures below 150C, i.e. cold water mains, chilled water, brine mains and other refrigeration lines, it is essential that maximum vapour tightness is maintained at fittings.
- 8.9.6 The insulation and vapour barrier either side of the fitting shall be carried into the box. At this point the vapour barrier shall be returned and taped to the pipe to eliminate the migration of water or moisture vapour into the insulation system.
- 8.9.7 Where the insulated box fits over the pipe insulation, the mating surfaces shall be sealed with a non- setting/non shrinking sealant, which shall also to be used in way to seal the spindles on valves and joining surfaces to the box.

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### 8.10 Finishings

#### 8.10.1 Internal Locations other than Plant Rooms

- Pipework Factory applied glass reinforced aluminium foil with joints sealed 50mm wide self-adhesive aluminium foil.
- Ductwork Factory applied glass reinforced aluminium foil with joints sealed 100mm wide self-adhesive aluminium foil.

#### 8.10.2 Plant Rooms

- Pipework As above, plus fabricated polished or hammered aluminium cladding of a thickness not less than 0.9mm.
- Ductwork As above, plus fabricated polished or hammered aluminium cladding of a thickness not less than 1.2mm.

#### 8.10.3 External Locations including Below Ground Ducts

- Pipework Plus 0.8mm thick polyisobutylene sheeting wrapped around the insulation with minimum 30mm overlap and sealed by solvent welding.
- Ductwork Plus two full applications of a polymeric emulsion mastic with reinforcement of number 10 glass cloth between coats.
- NB. Where insulating materials are finished with metallic cladding, bond the cladding in accordance with the latest edition of the IEE Regulations.

### 8.11 Identification

- 8.11.1 Identify all pipework whether insulated, insulated and cased, or uninsulated by self-adhesive colour banding having colours complying with BS 1710. Provide indication of direction of flow. Locate identification banding at all entries and exits to plant rooms, service ducts, voids etc. and at connections or branches to or from headers, pipe runs and the like. Otherwise, provide identification banding at intervals of not more than four metres.
- 8.11.2 Identification coding for ductwork shall be in accordance with the relevant appendices given in HVCA Specification DW/144.

### 8.12 Energy Conservation

- 8.12.1 The thickness of insulation shall comply with the current Building Regulations Approved Document L (conservation of fuel and power).

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### 8.13 Condensation Control on Refrigeration Pipework

- 8.13.1 The following thicknesses of Armaflex Class O thermal insulation shall be applied to refrigeration pipework applied in accordance with the Armstrong Armaflex Installation Manual (current edition) and installation techniques technical literature.

| Refrigeration                                               | Thickness |
|-------------------------------------------------------------|-----------|
| Refrigeration to -20°C<br>Pipes 15-42mm OD                  | 19mm      |
| Refrigeration to -30°C<br>Pipes 15-22mm OD Pipes 28-42mm    | 25mm      |
| Refrigeration to -40°C<br>Pipes 15-28mm OD Pipes 35-42mm OD | 25mm      |

### 8.14 Thickness of Insulation

- 8.14.1 The thickness of insulation material which is applied to the various services shall be as identified in Tables below.

**Table 1 - Schedule of Technical Requirements - Insulation Thickness for DHW System**

| Nom. OD of Pipe (mm) | Declared Thermal Conductivity (W/m°C)        |                |                |                |
|----------------------|----------------------------------------------|----------------|----------------|----------------|
|                      | 0.000 to 0.040                               | 0.040 to 0.055 | 0.055 to 0.070 | 0.000 to 0.040 |
|                      | Minimum Nominal Thickness of Insulation (mm) |                |                |                |
| 15                   | 20                                           | 32             | 50             | 50             |
| 22                   | 20                                           | 32             | 50             | 50             |
| 28                   | 25                                           | 32             | 50             | 50             |
| 35                   | 25                                           | 44             | 50             | 50             |
| 42                   | 25                                           | 50             | 50             | 50             |
| Flat Surfaces        | 35                                           | 65             | 65             | 75             |

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**Table 2 – Schedule of Technical Requirements - Insulation Thickness for Cold Water Systems (Frost Protection)**

| Nom. OD of Pipe (mm)                         | Declared Thermal Conductivity (W/mK) |               |               |                   |               |               |
|----------------------------------------------|--------------------------------------|---------------|---------------|-------------------|---------------|---------------|
|                                              | Pipework                             |               |               | External Pipework |               |               |
|                                              | with                                 |               |               |                   |               |               |
|                                              | 0.000 to 0.01                        | 0.019 to 0.04 | 0.040 to 0.05 | 0.000 to 0.01     | 0.019 to 0.04 | 0.040 to 0.05 |
| Minimum Nominal Thickness of Insulation (mm) |                                      |               |               |                   |               |               |
| 15                                           | 30                                   | 65            | 100           | 110               | 230           | 450           |
| 22                                           | 25                                   | 60            | 75            | 60                | 120           | 300           |
| 28                                           | 25                                   | 50            | 75            | 30                | 65            | 125           |
| 35                                           | 15                                   | 35            | 50            | 25                | 50            | 63            |
| 42                                           | 15                                   | 30            | 50            | 25                | 50            | 63            |
| Flat Surfaces                                | 15                                   | 19            | 25            | 15                | 25            | 32            |

**Table 3 - Schedule of Technical Requirements - Insulation Thickness for Warm Air Ductwork to control heat loss**

| Thermal Conductivity W/mK                                     |       |       | Maximum permissible heat loss (W/m <sup>2</sup> ) |
|---------------------------------------------------------------|-------|-------|---------------------------------------------------|
| 0.022                                                         | 0.040 | 0.050 |                                                   |
| Thickness of insulation (mm) with low emissivity facing: 0.05 |       |       | 16.34                                             |
| 20                                                            | 35    | 45    |                                                   |

**Table 4 - Schedule of Technical Requirements - Insulation Thickness for Condensation Control on Chilled Air Ductwork**

| Minimum Temperature of Air Inside Ductwork |      |      |      |      |      |      |      |      |      |      |      |
|--------------------------------------------|------|------|------|------|------|------|------|------|------|------|------|
| 0°C                                        |      |      | 5°C  |      |      | 10°C |      |      | 15°C |      |      |
| Thermal ConductivityW/mK                   |      |      |      |      |      |      |      |      |      |      |      |
| 0.02                                       | 0.04 | 0.05 | 0.02 | 0.04 | 0.05 | 0.02 | 0.04 | 0.05 | 0.02 | 0.04 | 0.05 |
| Thickness of Thermal Insulation (mm)       |      |      |      |      |      |      |      |      |      |      |      |
| 55                                         | 100  | 120  | 45   | 75   | 95   | 30   | 55   | 65   | 20   | 30   | 40   |

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### PART 9 ABOVE GROUND INTERNAL DRAINAGE

#### 9.1 General

- 9.1.1 The specification shall be used for all above ground internal drainage including foul and surface water drainage.
- 9.1.2 The installation shall conform to all relevant British Standards and Codes of Practice which are current at the time of installation. The Contractor's attention is particularly drawn to the following:
- |         |                                                                                              |
|---------|----------------------------------------------------------------------------------------------|
| NBS     | Specification Section R Disposal Systems                                                     |
| BS 4576 | Unplasticized PVC rainwater goods and accessories                                            |
| BS 4514 | Unplasticized PVC soil and ventilating pipes                                                 |
| BS 6367 | Code of Practice for drainage of roofs and paved areas BS 8000 Workmanship on building sites |
| BS 5255 | Thermoplastic waste pipe and fittings                                                        |
| BS 5572 | Code of Practice for sanitary fittings                                                       |
- 9.1.3 Allowance for expansion and contraction of the installation shall be made in accordance with the manufacturers' recommendations.
- 9.1.4 Pipework shall be supported independently directly from the structure no support shall be taken from any other services installation.
- 9.1.5 All adhesive used shall be fire resistant.
- 9.1.6 The Contractor may substitute the manufacturers named in this section of the specification with another equal and approved.

#### 9.2 Pipework and Fittings

- 9.2.1 Pipework shall be supported independently directly from the structure; no support shall be taken from any other services installation
- 9.2.2 Plastics Pipework for Soil Vent Pipes (NBS 110)
- |                                  |                                                                                                                              |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Pipes, fittings and accessories: | PVC-U to BS 4514, Kitemark certified.                                                                                        |
| Manufacturer and reference:      | Caradon Terrain Limited Soil System 100. Size(s): 110mm diameter. Colour: Black.                                             |
| Accessories:                     | bends, branches, access points, automatic air admittance valves, waste bosses, drain connectors and WC connectors, reducers. |
| Method of fixing:                | Caradon Terrain Limited Holderbat at 1800mm centres vertically and 900mm centres horizontally.                               |

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### 9.2.3 Plastics Pipework for Waste Pipes (NBS 120)

|                                  |                                                                                                       |
|----------------------------------|-------------------------------------------------------------------------------------------------------|
| Pipes, fittings and accessories: | PVC-U to BS 4514, kitemark certified.                                                                 |
| Manufacturer and reference:      | Caradon Terrain Limited Waste System 200. Size(s): 50 and 32mm diameter.                              |
| Colour:                          | White, to be confirmed.                                                                               |
| Accessories:                     | bends, tees, automatic air admittance valves. Traps shall be anti-siphon with 75mm seal.              |
| Method of fixing:                | Caradon Terrain Limited pipe fixing clip at 1200mm centres vertically and 500mm centres horizontally. |

### 9.2.4 Plastics Pipework for Overflow Pipes (NBS 130)

|                                  |                                                                                                       |
|----------------------------------|-------------------------------------------------------------------------------------------------------|
| Pipes, fittings and accessories: | PVC-U to BS 4514, kitemark certified.                                                                 |
| Manufacturer and reference:      | Caradon Terrain Limited Overflow System 500. Size(s): 19mm diameter.                                  |
| Colour: White, to be confirmed.  | Accessories: bends, tees, connectors.                                                                 |
| Method of fixing:                | Caradon Terrain Limited pipe fixing clip at 1200mm centres vertically and 500mm centres horizontally. |

### 9.2.5 9.2.5 Fire Protection Collars (NBS 200)

|                             |                                                                                                   |
|-----------------------------|---------------------------------------------------------------------------------------------------|
| Manufacturer and reference: | Caradon Terrain Limited Firebrake 3.                                                              |
| Sizes:                      | 110mm Reference 1725.4 50mm Reference 1725.2                                                      |
| Installation:               | Shall be built into masonry walls strictly in accordance with the manufacturer's recommendations. |

### 9.2.6 9.2.6 Floor Drain to Plant Room Floor (NBS 250)

|                             |                                                                                                                                                      |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Floor construction:         | Suspended concrete floor.                                                                                                                            |
| Manufacturer and reference: | Aco Fulbora Classic floor drain. Body type/material: Powder coated aluminium reference 3FFD<br>Grating/Cover type/material: aluminium reference GSF. |
| Outlet:                     | Type and direction to suit pipework with adaptors and connections recommended for the purpose by drain manufacturer.                                 |

## 9.3 Installation

### 9.3.1 Performance Criteria (NBS 510)

### 9.3.2 Above ground foul drainage pipework has been designed to BS 5572.

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- 9.3.3 Install pipework, fittings and accessories to ensure that:
- 9.3.3.1 Appliances drain quickly, quietly and completely at all times without nuisance or risk to health. Discharge is conveyed without crossflow, backfall, leakage or blockage.
  - 9.3.3.2 Air from the drainage system does not enter the building.
  - 9.3.3.3 Pressure fluctuations in pipework do not vary by more than 38mm water gauge and traps retain a water seal of not less than 25mm.
  - 9.3.3.4 The system can be adequately tested, cleaned and maintained.
- 9.3.4 Installation Generally (NBS 520)
- 9.3.4.1 Install pipes, fittings and accessories in accordance with BS 8000: Part 13, Section 3 and BS 5572.
  - 9.3.4.2 Obtain all components for each type of pipework from the same manufacture unless specified otherwise.
  - 9.3.4.3 Form junctions using fittings intended for the purpose.  
Fix pipes at centres not greater than those specified in BS 8000: Part 13.
  - 9.3.4.4 Provide additional supports as necessary at junctions and changes in direction. Fix every length of soil vent pipe at or close below socket collar.
  - 9.3.4.5 Where not specified otherwise use plated, sherardised, galvanised or nonferrous fastenings, suitable for the purpose and background and compatible with the material being fixed or fixed to.
- 9.3.5 Pipe Routes (NBS 540)
- 9.3.5.1 To be the shortest practical, with as few bends as possible and no bends in wet portion of soil stacks, unless specified otherwise. Pipe routes not shown on drawings to be approved before commencing work.
- 9.3.6 Connect Plastics Pipework (NBS 640)
- 9.3.6.1 To pipework of other materials using approved connectors and methods in accordance with plastics pipework manufacturer's recommendations, to form a watertight joint.
- 9.3.7 Electrical Continuity (NBS 710)
- 9.3.7.1 Use clips supplied for the purpose by pipework manufacturer to ensure electrical continuity at all joints in metal pipes with flexible couplings and which are to be earth bonded.
  - 9.3.7.2 Identification of Internal Foul Drainage Pipework (NBS 730)

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- 9.3.7.3 To BS1710 using self - adhesive bands or identification clips located at junctions, at both side of each slab, bulkhead and wall penetration, and elsewhere as directed.

### 9.4 Testing and Commissioning

#### 9.4.1 General (NBS 810)

- 9.4.1.2 Inform the Engineer sufficiently in advance to give him a reasonable opportunity to observe tests. Check that all sections of installation are securely fixed and free from obstruction and debris.
- 9.4.1.3 Ensure that all traps are filled with clean water.
- 9.4.1.4 Carry out tests as specified. After testing, locate and remedy all defects without delay and retest as instructed. Do not use smoke to trace leaks.
- 9.4.1.5 Keep a record of all tests and provide a copy of each to Engineer.

#### 9.4.2 Pipework Test (NBS 820)

- 9.4.2.1 Temporarily seal open ends of pipework with plugs.
- 9.4.2.2 Connect a 'U' tube water gauge and air pump to the pipework via plug or through the trap of an appliance.
- 9.4.2.3 Pump air into pipework until gauge registers 38mm.
- 9.4.2.4 Allow a period for temperature stabilisation, after which the pressure of 38mm is to be maintained without loss for not less than 3 minutes.

#### 9.4.3 Siphonage and Back Pressure Tests (NBS 830)

- 9.4.3.1 Test WC pans by flushing and test other appliances by filling to overflow level, then removing the plug.
- 9.4.3.2 Carry out tests at least 3 times with traps recharged before each test.
- 9.4.3.3 Test each appliance individually for self-siphonage, then test for induced siphonage and back pressure by discharging the following numbers of appliances simultaneously on each stack:
- WCs: 2
  - Washbasins: 2

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### **PART 10 SPRINKLERS**

**NOT USED**