

SECTION A TECHNICAL SPECIFICATION

INDEX:

1	GENERAL DESCRIPTION OF THE CONTRACT.....	5
1.1	SCOPE OF CONTRACT WORKS.....	5
1.2	DESCRIPTION OF PROJECT.....	5
1.3	SCOPE OF SERVICES	6
2	REMOVAL OF EXISTING SERVICES	8
2.1	GENERAL	8
2.2	SITE INSPECTION.....	8
3	BOILER-HOUSE INSTALLATION	9
3.1	INTRODUCTION.....	9
3.2	WALL HUNG GAS FIRED BOILER	9
3.3	LPHW CIRCULATING PUMPS AND ANCILLARY ITEMS.....	10
3.4	AUTO FILL UNIT-LPHW	11
3.5	BOILERHOUSE PIPEWORK	11
3.6	PIPE SUPPORTS.....	13
3.7	INSULATION AND CLADDING	14
3.8	COMMISSIONING SETS AND BALANCING VALVES.....	15
4	SOILS AND WASTES SERVICES	20
4.1	INTRODUCTION.....	20
4.2	SOIL PIPEWORK	20
4.3	GREASE FILTERS	21
4.4	FITTINGS AND ANCILLARIES	21
4.5	FIRE COLLARS	21
5	WATER SERVICES	22
5.1	INTRODUCTION.....	22
5.2	WATER SERVICES PIPEWORK.....	22
5.3	THERMOSTATIC MIXING TAPS FOR WHBs	23
5.4	PRESSURE REDUCING VALVES	24
5.5	FITTINGS.....	24
6	GAS SERVICES.....	25
6.1	INTRODUCTION.....	25
6.2	STANDARDS.....	25
6.3	GAS DISTRIBUTION PIPEWORK	26
6.4	GAS DETECTION SYSTEM.....	26
6.5	GAS PRESSURE PROVING SYSTEM	26
7	LOW PRESSURE HOT WATER (LPHW) HEATING SYSTEM	28
7.1	INTRODUCTION.....	28
7.2	LPHW CIRCULATING PUMPS AND ANCILLARY ITEMS.....	28
7.3	BOILERHOUSE PIPEWORK	29

7.4	DISTRIBUTION PIPEWORK	29
7.5	PIPE SUPPORTS	30
7.6	PIPE SLEEVES	30
7.7	INSULATION AND CLADDING	31
7.8	INSULATION OF VALVES AND FLANGES	32
7.9	COMMISSIONING SETS AND BALANCING VALVES	32
7.10	DYNAMIC PRESSURE INDEPENDENT CONTROL VALVES	32
7.11	ISOLATION AND REGULATION	33
7.12	COMMISSIONING POINTS	33
7.13	AUTOMATIC AIR ELIMINATORS	33
7.14	DRAINS	34
7.15	TUNDISHES	34
7.16	BY-PASSES	34
7.17	VIBRATION ISOLATION	34
7.18	EXPANSION BELLOWS	34
8	RADIANT PANELS	36
8.1	INTRODUCTION	36
8.2	RADIANT PANELS	36
8.3	RADIANT PANEL VALVES	36
8.4	TESTING	36
9	HEATER BATTERIES	37
9.1	INTRODUCTION	37
9.2	HEATER BATTERIES	37
9.3	LPHW DUCT HEATER BATTERIES	37
9.4	CONSTRUCTION	37
9.5	PERFORMANCE AND SELECTION	38
9.6	PRESSURE RATING AND TESTING	38
9.7	INSTALLATION	38
9.8	PIPEWORK CONNECTIONS	39
9.9	CONTROL	39
9.10	FROST PROTECTION	39
9.11	CORROSION PROTECTION	39
9.12	SUBMITTALS	39
9.13	COMMISSIONING	40
10	VENTILATION DUCTWORK AND FITTINGS	41
10.1	INTRODUCTION	41
10.2	DUCTWORK AND FITTINGS	41
10.3	FLEXIBLE DUCTWORK	41
10.4	VOLUME CONTROL DAMPERS	42
10.5	ACCESS OPENING	42
10.6	REMOVABLE ACCESS COVER	42
10.7	ACCESS OPENINGS IN INSULATED DUCTS	42
10.8	TEST HOLES FOR INSTRUMENTS	43
10.9	INSULATION	43
10.10	WEATHERPROOFING	43
10.11	PAINING	44
10.12	DIFFUSERS AND GRILLES	44
10.13	CONNECTIONS TO EXTERNAL LOUVRES AND TERMINALS	44
10.14	DUCTLINE NOISE ATTENUATION	44
10.15	MANOMETERS	45
10.16	DUCT THERMOMETERS	45

10.17	DUCTWORK IDENTIFICATION	45
11	EXTRACT AND SUPPLY FANS	46
11.1	INTRODUCTION	46
11.2	CENTRIFUGAL FANS	46
11.3	AXIAL FLOW FANS	46
11.4	PASSIVE INFRA-RED (PIR) CONTROL	47
11.5	WALL CONTROLLERS	47
12	KITCHEN CANOPY AND FIRE SUPPRESSION SYSTEM	48
12.1	INTRODUCTION	48
12.2	GENERAL	48
12.3	KITCHEN FIRE SUPPRESSION SYSTEM	52
13	HVAC CONTROLS AND BUILDING ENERGY MANAGEMENT SYSTEM	54
13.1	INTRODUCTION	54
13.2	BUILDING MANAGEMENT SYSTEM (B.M.S.) GENERAL REQUIREMENTS	54
13.3	GAS INTERLOCK	55
13.4	WIRING AND INSTALLATION OF TEMPERATURE DETECTORS AND PANELS	55
13.5	OUTSTATIONS	55
13.6	ELECTRICITY METER MONITORING	57
13.7	MAINS AND COLD WATER METERS	57
13.8	GAS METERS	57
13.9	LEGIONELLA ALERT SENSORS	57
13.10	WEATHER COMPENSATION CONTROL	57
13.11	BOILER FROST PROTECTION	57
13.12	AUTO FILL UNIT - HIGH AND LOW LIMIT PRESSURE SWITCHES	58
13.13	BOILERHOUSE - TEMPERATURE MONITORING AND CONTROL	58
13.14	BOILER SEQUENCING	58
13.15	DIFFERENTIAL PRESSURE SWITCHES FOR PUMPS	58
13.16	CONTROL VALVES	58
13.17	PIPE MOUNTED TEMPERATURE SENSORS	59
13.18	WALL MOUNTED TEMPERATURE SENSORS AND SET POINT ADJUSTERS	59
13.19	WEATHERPROOFING OF EXTERNALLY MOUNTED CONTROLS EQUIPMENT	60
13.20	HWS SYSTEM	60
13.21	COMMISSIONING / HANDOVER	60
14	SANITARY FITTINGS	62
14.1	INTRODUCTION	62
14.2	CONNECTION OF SANITARYWARE	62
15	SUPPORT FOR PLANT AND EQUIPMENT	63
15.1	INTRODUCTION	63
15.2	SUPPORT FOR PLANT AND EQUIPMENT ON ROOFS	63
16	TESTING AND COMMISSIONING OF MECHANICAL SERVICES	64
16.1	INTRODUCTION	64
16.2	PRE-COMMISSION CLEANING	64
16.3	DUCTWORK SYSTEMS	65
16.4	MAINS WATER	65
16.5	HOT AND COLD WATER SERVICES & COLD WATER STORAGE TANKS	65
16.6	SOILS AND WASTE SYSTEM	66

16.7	Low Pressure Hot Water Systems	66
17	LABELLING OF MECHANICAL SERVICES.....	67
17.1	INTRODUCTION.....	67
17.2	PLANT IDENTIFICATION	67
17.3	DRINKING WATER IDENTIFICATION	67
17.4	DUCTWORK IDENTIFICATION	67
17.5	PIPEWORK IDENTIFICATION.....	68
17.6	PLANT IDENTIFICATION.....	68
17.7	DRINKING WATER IDENTIFICATION	68
17.8	VALVE IDENTIFICATION.....	69
18	OPERATION AND MAINTENANCE MANUALS.....	70
18.1	INTRODUCTION.....	70
18.2	MECHANICAL OPERATIONS AND MAINTENANCE MANUAL	70
19	HANDOVER	72
19.1	INTRODUCTION.....	72
19.2	HAND-OVER CERTIFICATES.....	72
19.3	INSTRUCTION OF EMPLOYERS STAFF.....	72

1 GENERAL DESCRIPTION OF THE CONTRACT

1.1 Scope of Contract Works

The Contractor shall include for the complete supply, delivery, off-loading, installation, connection, testing and commissioning of all plant, equipment and materials shown on the drawings, described in this specification, and otherwise necessary to provide fully complete, operational and satisfactory Mechanical Services installations at Cavan Institute, Cathedral Road, Cavan, Co. Cavan.

All services shall be provided in accordance with the relevant Standards, Codes of Practice, the Department of Education TGDs, Local Authorities and Statutory Bodies requirements. The completed electrical services installations shall be handed over to the Client in a condition suitable for immediate use.

The schedules and drawings accompanying this specification, whilst indicating the extent of the works, do not purport to be Bills of Quantities and do not include such items as fixings, accessories, etc., which shall be supplied together with all other items, whether specifically mentioned or not, necessary to complete the installation in every respect.

Any difference between, or omission from, the said drawings and specification shall not absolve the Contractor from liability to provide a complete installation in accordance with the true meaning and intent of all taken together. The Contractor shall supply and erect everything implied therein requisite to the satisfactory completion and convenient working of the installation.

The Contractor is deemed to have visited the site prior to completing his tender and satisfied himself as to the site conditions, e.g. accessibility and local conditions.

Each service, when complete, shall be tested and commissioned in full accordance with the relevant sections of this specification and the various commissioning procedures lay down by the professional bodies.

Any equipment, appliance or material not shown on the drawings, but mentioned in the specification or vice versa, or any minor details or accessories not shown or specified, but necessary for the proper installation and operation of the contract works, shall be delivered, supplied and installed by the mechanical contractor, without additional expense to the contract.

1.2 Description of Project

The project comprises the complete strip-out and remodelling of the existing training room to form a new catering/training facility. The proposed layout will require the installation of new mechanical and electrical services to serve the catering equipment, associated ventilation and extract systems, lighting, small power, controls and all other ancillary services required for the completed installation.

A new suspended ceiling will be installed throughout the area, with the ceiling void accommodating a significant proportion of the new mechanical and electrical services. The ceiling void will be relatively congested due to the space required for ventilation ductwork, extract systems, cable containment, lighting services and other associated equipment.

The Mechanical and Electrical Contractors, together with their respective sub-contractors, shall liaise closely with each other and with the Main Contractor prior to commencement of first-fix works. Particular attention shall be given to the coordination of all services within the ceiling void and around the catering extract hoods, taking account of the physical dimensions of the ductwork, required clearances, access for maintenance, electrical supplies to mechanical plant and equipment, fire stopping requirements and the locations of ceiling-mounted equipment.

Prior to commencing any first-fix works, the Mechanical and Electrical Contractors shall liaise with the catering equipment supplier(s) and shall confirm the final service requirements for all catering

equipment. This shall include, but shall not be limited to, electrical power requirements, supply voltage and phase, connected loads, gas supplies, cold and hot water supplies, drainage and waste connections, ventilation requirements and any associated controls or interlocks. The Contractors shall verify the required connection sizes, ratings, locations and termination arrangements against the final approved catering equipment selections and manufacturer's installation requirements. Any discrepancies between the tender information, drawings, equipment schedules and the catering equipment supplier's requirements shall be brought to the attention of the Design Team prior to commencement of first-fix works.

The Contractors shall fully coordinate their installations in advance of first fix and shall ensure that sufficient space is maintained for all services, access panels and future maintenance requirements. Any potential clashes or coordination issues shall be identified and resolved before installation works commence. Services shall not be installed on a first-come, first-served basis where this would restrict the installation or maintenance of other services.

Where required, coordinated services drawings shall be prepared and agreed between the relevant contractors prior to installation. The final arrangement of services shall also be coordinated with the suspended ceiling grid, lighting layout, extract hoods, fire alarm devices, access panels and all other ceiling-mounted equipment to provide a neat, coordinated and fully maintainable installation.

1.3 Scope of Services

The Contractor shall include for the supply and installation of the following systems:

1.3.1 Existing Services

Existing services within the works area shall be disconnected and removed. The systems shall be stripped back to the first suitable existing point and altered and extended as necessary to suit the new layout.

1.3.2 Soils and Wastes Systems

The above ground drainage shall comprise dedicated soils and wastes drains from each item of sanitary ware to dedicated builders upstands at ground floor level.

1.3.3 Water Services

The water services for the building shall be served from existing systems. The Hot Water generation shall be from existing hot water calorifier. The potable water supply to the Bar Sink and the coffee station shall comprise a dedicated service from the incoming main in the existing plantroom.

1.3.4 Gas Services

The gas services for the new kitchen shall be served from existing plantroom. The service shall be complete with new gas Pressure Proving Panel, Gas Pressure Proving Valve, Secondary Lockstop and Ventilation Interface

The gas services for the new plantroom shall be served from existing site service. The service shall be complete with a new gas detection panel, Gas Slamshut Valve and Gas Sniffers.

1.3.5 Space Heating Services

A new gas Fired Boiler shall be provided in a dedicated plantroom to service the heater batteries in the Catering Room. The plan shall comprise Gas Fired Balance flue boiler, Flue to atmosphere, circulating pump, expansion equipment, low loss header and all ancillaries. A new LPHW circuit from a new Plantroom shall be distributed to serve new heater batteries on the supply systems to the canopies.

Radiant heating panels shall be provided within the student area and connected to the existing heating pipework, with connections extended from the locations of the existing heating network.

1.3.6 Ventilation Services

A tempered fresh air system shall be provided to the catering kitchen via inline supply fans located in the ceiling void. The fans shall be equipped with Heater Batteries to temper the air and filter boxes. The fresh air will be distributed to the ceiling void via a ducted system and connected to a plenum box on the canopies.

A dedicated extract system shall be provided to the new kitchen canopies split between the chefs area and the students area and a dedicated extract system shall service the condense canopy.

1.3.7 Motor Control Centre and Automatic Controls

A new Motor Control Panel shall be provided in the new Plantroom serving the new Catering Room . The panel shall include facility to control all new plant and connect to the existing controls network via the existing control panel in the adjacent plantroom. The works shall include a remote keypad for controlling the systems.

2 REMOVAL OF EXISTING SERVICES

2.1 General

The Contractor shall include for disconnecting and removal from site of obsolete services and materials.

The redundant items of equipment/building material shall be removed from site by the Contractor and disposed of in an approved manner complying with current health and Safety and Environmental Health Regulations.

2.2 Site Inspection

The extent of the existing services is not indicated on the drawing. The Contractor shall be deemed to have inspected the site and made an assessment of the work involved prior to submitting his tender. The Contractor is strongly advised to inspect the site before completing his tender. The Engineer will entertain no claims for extras arising out of lack of knowledge of site conditions and site access.

3 **BOILER-HOUSE INSTALLATION**

3.1 **Introduction**

The Contractor shall include for the supply and installation of the complete Boiler Room fitout serving the school as follows:

- Boiler and flue
- Circulating pump
- Expansion vessel
- Autofill unit
- Heating pipework
- Insulation
- Commissioning sets and balance valves.

The Contractor shall be responsible for the supply, installation, commissioning and demonstration of the complete LPHW heating system. He shall be responsible for the performance of the finished LPHW systems.

The LPHW heating system installation shall comply with all relevant standards (IS, BS & EU), as well as best industry practice. It shall be responsibility of the contractor to demonstrate compliance with all relevant standards.

3.2 **Wall Hung Gas Fired Boiler**

The Contractor shall supply, install and commission the number of gas boilers as indicated on the drawings. The boiler installation shall be a proprietary cascade arrangement system.

The boilers shall be wall mounted, gas fired, modulating units capable of fully modulating turndown 20-100%, to ensure efficient operation. They shall be suitable for natural gas fuel.

The boiler shall be complete with casings, adapted for room sealed usage with low level discharge, gas and water connections to bottom, shunt pumps, control and limit thermostats, pre-mix gas fired Reduced NOx gas burners complete with aluminium finned heat exchanger, supplied pre-assembled. The boiler shall be complete with a minimum 5 year full warranty.

The condensing section shall have a trapped condensate outlet. Connections from this outlet and from a trapped outlet at the chimney base shall be extended in polypropylene piping to the nearest suitable drain at a gradient of 3% minimum.

The boilers shall be tested as erected in their final positions.

The boiler plant shall be commissioned by the manufacturers' representative.

The boiler shall be installed with allowance made for the manufacturers' recommended clearance for access and maintenance.

The boiler shall be supplied with a balanced flue kit complete with all necessary bends, offsets, fasteners, sleeves and terminations deemed necessary to complete the installation and in accordance with manufacturer's recommendations and building regulations.

The flue terminal positions are in accordance with the safety distances set out in IS 813. Consideration may be given to siting a condensing boiler flue terminal such that the plume of wet flue products does not impinge on or significantly affect the use of the dwelling and also the neighbouring buildings. Care may need to be taken to locate flue outlets from condensing boilers away from parts of a building that may be damaged by frequent wetting. The direction of the flue

may be altered by specialist diversion kits which should be appropriate for the flue, appliance and fuel being used.

Further detailed guidance regarding the location of flue outlets is contained in IS 813: 2002/A1: 2004 (under revision) and I.S. 820: 2010.

3.3 LPHW Circulating Pumps and Ancillary Items

The heating circulating pumps shall be glandless inline single head circulating pumps, suitable for pipe-supported installation with integrated electronic speed regulation for constant or variable head control as indicated.

All pumps will be provided with integrated variable speed drives, c/w integral pressure transducers, and associated pressure sensors as standard.

All glandless pumps shall be 'A' rated (EEI <0.23) as a minimum.

All glanded pumps shall have a minimum energy rating of IE2 (EFF1).

All pump VSD's shall be capable of turning down to 0% of total flow/pressure, against a deadhead.

They shall conform to the following materials specification:

- Stator Housing - Fine grain cast iron
- Pump Housing - Fine grain cast iron
- Impellor - Stainless steel
- Rotor can - Stainless steel
- Rotor shaft - Stainless steel
- Bearings - Polished ceramic.

The rotor shall be fully immersed in the system fluid. It shall be accurately machined to fit the stainless rotor can in which it shall rotate freely. The can shall retain the system fluid and shall be automatically vented at the top by, means of an air vent and rotation indicator assembly.

Where variable head pumps are specified adjustments shall be achieved by slip streaming through the pump volute. The adjusting mechanism shall be operated by an adjusting knob in the base of the suction housing that shall be extended to an eccentric diaphragm in the pump volute.

Pumps shall be suitable for water temperatures up to 110°C and 6 bar pressure. Pump installations shall always be carried out with shafts horizontal.

All internal parts shall be highly corrosion-proof and wear resistant and shall be machined for minimal frictional losses. They shall be quiet in operation. Pumps shall be self-lubricating.

Pump sizes up to and including 25mm bore shall be screwed union jointed. Above this size all pumps shall be flange jointed and supplied with matching counter flanges with bolt or studs all to BS 4504.

Pumps shall be fitted with gate type valve on both connections or where fitted beside automatic control valves, common gate valve may be used for isolation of both items. Pumps shall be fitted with plugged pressure tappings on inlet and outlet connections (between valves).

All pumps shall be clearly marked showing direction of rotation and flow direction. The pump plate shall be clearly marked with manufacturer's name, model, electrical requirements in volts, amps, phasing and frequency in Hertz. Serial number and means of identifying year of manufacture and replacement part requirements shall also be provided.

3.4 Auto Fill Unit-LPHW

The auto filling unit shall be a fully packaged pressurisation unit complete with end suction pumps; pressurisation vessel fitted with removable diaphragm; break tank, cover and ball cock; foot valve; pump control pressure switch; pressure gauge; high and low pressure cut-out switches, hydraulic accumulator and low water protection.

It shall be complete with a Motor Control Centre complete with power on light, run and trip lights, high and low pressure lights, low water level light, door interlocked isolator, automatic pump change-over, B.M.S. interface, base plate, etc.

The expansion vessel shall be appropriately sized to suit the installation.

Pressurisation equipment shall be of packaged construction with provision for simple connection to plant and plant control systems. Where practical it shall be mounted on a common base-frame.

Pressurisation (unit)s and their controls shall be arranged to fail safe.

Provision shall be made for quick-filling the system(s) in parallel with the make-up water system(s) provided for normal service.

Prior to placing an order, the Contractor shall submit full details of the proposed equipment to the Engineer for approval.

3.5 Boilerhouse Pipework

The low-pressure hot water (LPHW) pipework shall be mild steel, medium grade to BS 1387 up to 125mm diameter. Over 125mm diameter it shall be steel to BS 3601 of a wall thickness of not less than 6mm.

It shall be new, clean, free from defects, of even bore throughout and delivered to site with the manufacturer's protective coating undamaged. All pipework shall be welded throughout, using B.S. EN 10253 – 1 1999, welding fittings.

All pipework in ducts shall be painted with red oxide by this Contractor. Where pipework passes through walls or floors, it shall be sleeved with metal sleeves, finishing flush with the finished wall or floor surfaces.

The Contractor shall include for all recesses, supports and brackets, including supports for pipework on the timber trusses in the pitched roof etc. The Contractor shall supply and install automatic vents on all high points and drain cocks on all low points, of the pipework system, whether shown on the drawings or otherwise.

All pipework supports shall be in strict accordance with B.S. 3974.

All pipework in the boiler house, ceiling voids, low level, high level floor ducts or roof spaces, shall be welded using B.S. EN 10253 – 1; 1999 welding fittings.

3.5.1 Welded Pipework (under 6.2 bar Working Pressure)

Where it is specified that piping shall be jointed together by welding the contractor shall comply with the following:

- Piping of 50mm bore and below may be oxyacetylene or electric arc welded.

- Piping of 65mm bore and over shall be electric arc welded.

Oxyacetylene welding shall conform to BS 2640, Class II oxyacetylene welding of steel pipelines and pipe assemblies for carrying fluids, and the publication dated 1970 entitled “Welding of Mild Steel Pipework” as issued by the Heating and Ventilating Contractors Association.

Electric arc welding shall conform to BS 2971 Class II metal arc welding of steel pipelines and pipe assemblies for carrying fluids, and the above HVAC Publication.

If requested by the Engineer samples of the filler rod or electrodes to be used shall be submitted to the Engineer for approval before any work commences on site.

The contractor shall make arrangements for the dry storage of filler rods and electrodes to prevent deterioration.

All welding shall be executed by competent certified welding operatives fully experienced in the class of work to be undertaken.

The competence of the welder shall be judged in accordance with “Recommended Practice and Test Certificates of Competency for Oxyacetylene and Metal Arc Welds in Mild Steel Pipework” issued by the Heating and Ventilation Contractors Association.

The Contractor shall ensure that all welds are cleaned and protected from rust.

Where tack welds are used to secure alignment, there shall be four equally spaced around the circumference of the pipe. Each tack shall be of the same quality as the final weld, with full penetration at the throat or vee or fillet and of a length equal to twice the pipe thickness. Tack welds shall be examined visually for defects by the welder and if found defective, they shall be removed completely.

The Contractor shall allow in his tender price for radiographic testing of 5% of all welds on BS 1387 heavy weight carbon steel at positions chosen by the Engineer for their inspection during the course of the contract.

Should any of these welds prove to be defective, the contractor will be required to cut out and renew the completed welds, and further to have radiographed two more welds. If any of these fail it shall be rectified and two further welds radiographed and so on.

Radiographic inspection shall be to API standard 1104, with tolerance doubled.

3.5.2 Welded Branches

The Engineer may, at their discretion, accept the use of welded branches in place of standard butt welding tees. Welded branches will only be accepted if each of the following conditions is observed:

The branch shall be profiled to suit the contour of the main pipe and a hole shall be cut in the latter, having a diameter equal to the bore of the branch in the case of a set-in type branch weld. The branch weld shall be located accurately, tack welded into position and finally welded.

The highest standard of general workmanship, marking, cutting and welding shall be employed in the making of a branch weld. Before any branch welding is carried out the Engineer shall be at liberty to inspect the Contractor's technique in this matter. If in the Engineer's opinion, the contractor is not capable of making branch welds of sufficiently high quality, standard prefabricated butt-welding tees will be required throughout the installation.

In certain cases, the Engineer may direct the installation of reinforcing pads on a branch weld. These shall be installed by shaping a plate or plates to the contour of the pipe and butting a hole in the plate so that it clears the branch weld. This plate shall be welded to the pipe. Before welding is commenced adequate provision shall be made for the escape of air from the plate by drilling a small diameter hole therein.

3.5.3 Sets

Site made sets, including offsets, shall be made cold in bending machine up to and including 50mm diameter bore. Distorted or flattened sets shall be rejected. Mitred or kinked sets shall not be accepted.

3.5.4 Welding Fittings

Welding fittings shall be mild steel with bevelled edges and shall be of similar actual bore and gauge to the relevant steel tube and shall be in accordance with BS 1965 where applicable.

Welding branches shall be manufactured branch bend pieces swept, bevelled and contoured for welding to mains. Hole required in the main tube may be cut with oxyacetylene torch provided that flame-cut edge is filed away completely, dressed and cleaned out before welding is commenced.

3.5.5 Painting

All factory-finished items shall be touched up if scratched or chipped. Badly damaged items shall be replaced without charge to the client.

3.6 Pipe Supports

All pipe supports, hangers and brackets required to support and control the movement of pipework shall be supplied and erected by the Contractor and shall be fixed to the building structure independent of plant and equipment. The Contractor shall obtain the approval of the Engineer of the type and spacing of the supports, hangers and brackets prior to erection.

Pipework shall be supported adequately and in such a manner as to permit free movement due to thermal expansion and contraction. Where pipes are thermally insulated the insulation shall be carried through the support. Vapour barriers shall not be pierced or damaged.

All sharp edges and cut ends on pipe supports, brackets, etc. shall be suitably protected. Pipework shall be supported at a change in direction unless other agreed with the Engineer. Pipework supports shall be arranged as near as possible to the joints.

Supports on horizontal pipework shall be spaced at not more than the following intervals: -

Horizontal Steel Pipework Support Spacings	
Pipe Size (mm)	Support Interval (mm)
15	1800
20	2400
25	2400
32	2400
40	2400
50	2400
65	3000
80	3000
100	3000
125	3700
150	4500
200	6000

250	6500
300	7000

Support on vertical pipework shall be spaced at not more than the following intervals: -

Vertical Steel Pipework Support Spacings	
Pipe Size (mm)	Support Interval (mm)
15	2400
20	3000
25	3000
32	3000
40	3700
50	3700
65	4600
80	4600
100	4600
125	5500
150	5500
200	8500
250	9000
300	10000

3.6.1 Pipe Sleeves

In all cases where pipes pass through walls, non-load bearing partitions, floors, ceilings and footings, sleeves shall be provided and it shall be ensured that the sleeves are correctly built-in. Sleeves shall in no case be used as pipe supports, a free annular space always being provided.

3.7 Insulation and Cladding

The Contractor shall include for insulating all heating pipework in the boilerhouse.

All heating pipework shall be fully insulated and shall comply with Technical Services Document Building Regulations providing a thermal conductivity of not greater than 0.035 w/mK. Pipework insulation shall comply with B.S. 5422, 2001 & BS EN ISO 12241: 1998.

Boiler house pipework shall be insulated with Armaflex Class 0 insulation

The pipework insulation shall be comprised of rigid preformed pipe sections, wrapped in factory applied reinforced aluminium foil laminate complete with integral self-adhesive lap and light gauge aluminium bands at not more than 450mm centres. Pipework insulation shall be 25mm for pipes up to 35mm and 30mm for pipes up to 54mm.

The Contractor shall ensure that all surfaces are clean and dry before insulation is applied.

All piping and equipment shall be tested and approved before insulation.

Insulation thickness shall be as follows: -

- | | |
|--------------------------|------------------------|
| • Up to 19mm dia. | 25mm thick insulation |
| • 25mm dia. to 32mm dia. | 25mm thick insulation |
| • 38mm dia. to 50mm dia. | 32mm thick insulation |
| • Over 50mm dia. | 40mm thick insulation. |

Insulation valve jackets shall be provided on all primary and secondary heating circuits to minimise heat loss. Jackets shall be appropriately sized for each valve and be secured with heavy duty Velcro.

3.8 Commissioning Sets and Balancing Valves

The contractor shall include for the supply and installation of commissioning sets and balancing valves as required to enable complete commissioning of the entire heating system.

The Contractor shall supply, install and commission double regulating balancing valves at each motorised valve position and elsewhere as indicated on the drawings and as necessary to ensure the proper running of the heating systems.

Double regulating valves shall be of Tour & Anderson manufacture and of the following types;

- | | |
|-----------------------|------|
| • Up to 65mm diameter | MD41 |
| • 80mm and larger | MD54 |

For accurate measurement of the system the minimum distance of straight shall be 10 times the pipe diameter upstream to the flow measuring device and 5 times the pipe diameter downstream of the flow-measuring device to prevent false readings due to turbulence.

A gate valve shall be installed on the flow and return at each commissioning set location for isolation purposes.

Regulating valves, orifice units and commissioning sets shall be fitted with Binder Twinlock test plugs.

The manufacturing tolerances shall ensure a main flow rate of water within +/- 5% of a given pressure differential measurement on a manometer. Commissioning sets shall be selected against their relative flow rate to ensure that the minimum pressure signal as recommended by the valve manufacturer is obtained to ensure accurate readings.

3.8.1 Dosing Pots

The contractor shall supply and install 1 no. 100L chemical dosing pot as manufactured by Chempack. The pot shall come complete with fill point and all necessary isolating valves. Dosing pot shall be securely bracketed to the wall.

Prior to practical completion, suitable corrosion inhibitor shall be added (at a 5% system content ratio) to the system by a specialist sub-contractor. The mechanical contractor shall note all types of heat emitters and heating plant associated with the system. The type of inhibitor used shall not adversely affect such equipment.

3.8.2 Isolation and Regulation

Valves, cocks and stop taps for isolation and/or regulation shall be provided where shown in the drawings and on the mains to isolate major sections of distribution, on the base of all risers and droppers except in cases, where one item of apparatus only is served which has its own local valve or stop tap, on all sub-circuits of closed systems, on points of pipe connection of all items of apparatus and equipment except where the item could conveniently be isolated or regulated by valves provided for other adjacent items and on draw-off fittings except where ranges of fittings are served by a common float, the isolator then being fitted with the float.

3.8.3 Commissioning Points

'Binder' type tappings for commissioning purposes shall be provided, numbers and locations to be agreed with Engineer.

Generally self-sealing test points shall be provided on all secondary headers, heating and cooling piping main branches, each port of each automatic control valve, inlet and outlet of each heater and cooler battery or terminal unit, and entry and exit from each plant room heating and chilled water service.

Test points shall be mounted on the side of pipes and shall be dual purpose for pressure gauge and thermometer, and shall repeatedly reseal.

3.8.4 Strainers

Bronze 'Y' type pattern strainers shall be used on pipelines up to 54mm as scheduled and cast iron strainers shall be used on pipelines over 54mm as scheduled.

All strainers shall have a mesh of an approved size and shall be suitable for the working pressure of this system to which they are installed. Strainer shall be flanged on sizes of 65mm and over and shall be provided with drain facilities in the clean out connection at the bottom of the body construction. Strainers shall be fitted with isolating valves upstream and downstream to facilitate maintenance.

3.8.5 Air Separators

Air separators shall be flexcon Type S as manufactured by Flamco or approved equal. The separator shall be complete with an auto vent, shut off valve and shall be installed as per manufacturer's instructions. Baffles shall not be able to re-entrain the separated water.

3.8.6 Location of Pressure Gauge Points

A female screwed outlet on the pipelines and a gauge cock for pressure gauge points shall be used.

Pressure gauge points shall be located where shown on the drawings, on suction and delivery sides of every pump, on flow and return connections to air/liquid heat transfer coils, including fan coil units on connections to heater batteries of storage and non-storage calorifiers and on point of entry of each pipeline into Plant Rooms.

3.8.7 Location of Temperature Tapping Points

For temperature tappings points a female screwed outlet shall be used on the pipeline and fitted a thermometer pocket.

Where thermometers are not fitted permanently a blanking plug shall be used in the open of the pocket.

Pockets shall be generally inserted into pipelines at right angles to the pipeline axis. On pipelines, up to 32mm size, the pipeline must be locally enlarged to at least 80mm size or the pocket may be inserted at a bend or inclined to the pipeline axis.

At least 75mm of the thermometer pocket shall be in contact with the pipeline contents.

Temperature tapping points shall be located where shown on the drawings, on connections to air/liquid heat transfer coils, on connections to heater batteries of storage and non-storage calorifiers and on point of entry of each pipeline into Plant Room.

3.8.8 Automatic Air Eliminators

Bronze automatic air eliminators shall be used with integral lockshield valve on inlet and check valve

on outlet, manufactured to facilitate grit removal whilst in service.

Screwed female connections shall be provided on pipelines of all sizes.

Integral 10mm hard soldered copper discharge pipeline shall be provided.

Air release pipes shall be run to discharge at the nearest suitable visible safe point.

3.8.9 Drains

Drain cocks, not less than 15 mm, with hose connections, shall be fitted at low points in the pipework distribution systems and local to items of equipment and headers.

Drain valves shall be fitted to common flow and common return lines and shall be of the same size as the largest pipe size of any sub-circuit.

Drain valves, shall be fitted to facilitate flushing and cleaning of pipework where indicated on the drawings and where required. Drain valves shall be bronze lockshield globe or gate valves to BS 5154, with hose union connector.

Drain valves or cocks shall be lockable except where prohibited by the local water authority.

3.8.10 Tundishes

Tundishes shall be fabricated from 3mm thick mild steel plate, to give a large end diameter of 100mm and a small end diameter of 25mm with an included apex angle of 30 degrees. Weld a 25mm female screwed boss to the small end. Galvanised after manufacture.

Pressure relief or combined pressured and temperature relief pattern valves shall be used to the appropriate British Standards.

Safety valves for boilers, heating calorifiers and all pressure vessels shall be provided irrespective of whether shown on the drawings or not.

Safety valves for steam, HTHW and MTHW shall be as indicated on the drawings and the Specification.

3.8.11 Test Points, Gauges and Thermostat Pockets

Every heat generator or heat exchanger unit shall have no less than one temperature gauge and one pressure gauge for efficient control and running.

Each main branch circuit leaving a heat generator or heat exchanger plant room shall be fitted with a temperature gauge and pressure gauge on the flow and a Binder Twinlock test plug on the flow and return.

In order that the installations may be accurately balanced and set to work, test plug points for temperature and pressure tests shall be provided on flow and return connections to all items of equipment and around mixing valves as shown on our drawings.

Test plug points shall consist of connections made into the pipework and fitted with a Binder Twinlock test plug (Binder test points shall not be used on high pressure systems or steam). The test plugs shall be extended to the surface of any insulation applied to the pipework.

Temperature test pockets shall be located and be of sufficient depth as to ensure a true reading of the fluid temperature. Where the pipework size is below 42mm, the pipework accommodating the test pockets shall be increased locally to 50mm so as not to affect the flow rate and response of the gauge/thermostat. Pockets shall be filled with mineral oil and the thermometers fixed so that the

tails are truly subjected to the temperature of the fluid to be measured.

Boilers shall have a minimum of a flow temperature gauge, a return temperature gauge and a pressure gauge. Non-storage water/water heat exchangers shall have flow and return temperature gauges on both primary and secondary sides with one pressure gauge on the secondary shell side. Steam heat exchangers shall be as for water/water with additional pressure gauges on primary circuits.

Circulating pumps shall have pressure gauges on both suction and delivery connections.

Except where gauges form part of a 'packaged unit' they shall be no less than 100 mm diameter for mounting heights up to two metres from floor level and 150mm diameter above two metres.

All temperature gauges shall comply with BS 5235, dial type mercury in steel, and shall be installed with removable brass pockets filled with conductive gel.

All pressure gauges shall comply with BS EN 837-1:1988, and shall be complete with syphons and gauge cocks and shall have 10mm connections. Syphons shall be of the same material as the pipework.

The proposed calibration range for all gauges shall be submitted for approval prior to ordering.

All capillary tubes to remote gauges shall be supported upon their entire length, including the final connection to the equipment, on PVC coated tray.

3.8.12 By-Passes

Fixed by-passes shall be provided around all items of plant, equipment or ancillaries which may be subject to damage during flushing or testing and commissioning.

3.8.13 Vibration Isolation

All dynamic machinery shall be isolated from the building structure by vibration isolators and/or vibration isolation materials which shall be purpose designed and selected to suit the machinery.

Where mat type isolation materials are used, the Contractor shall supply the materials and be responsible for their correct location; all other vibration isolators shall be supplied and installed by the Contractor.

For pumps and water distribution systems, purpose-designed flexible connections shall be provided to minimise the transmission of vibration. The connections shall be compatible with the tube materials and methods of jointing and the fluid handled in the system.

3.8.14 Expansion Bellows

The expansion bellows shall be provided to absorb the movement of the pipelines as fabricated by one of the scheduled firms to BS 6129 and ensure compatibility with the pipeline service and materials. When installing manufactured expansion loops or bellow joints, the manufacturer's installation recommendations shall be observed in every respect.

On Low Pressure systems single wall, convoluted, stainless steel bellows with internal sleeves shall be used, and screwed or welded connections up to 50mm or flanged connections over 50mm

On Secondary Low pressure systems single wall, convoluted, stainless steel bellows with internal and external sleeves shall be used, and screwed connections up to 50mm or flanged connections over 50mm

The expansion bellows shall be installed with great care to ensure no misalignment of the bolt holes and mating flanges and ensure that heat from welding process does not affect bellow materials.

Pre-stress shall only be in accordance with the manufacturer's instructions. Before expansion load is applied any temporary installation, bars shall be removed.

When pressure testing pipework distribution it shall be ensured that the test pressure will not damage the bellows, anchor points, guides and the building structure. Spacer pieces shall be fitted in place of bellows, during any pipeline testing which may affect bellows.

4 SOILS AND WASTES SERVICES

4.1 Introduction

Under this section the Contractor shall include for the supply and installation the soils and waste services as follows:

- Soil pipework
- Overflow pipework
- Waste pipework
- Labelling
- Testing and commissioning.

It shall be the responsibility of this Contractor to co-ordinate the installation of the soils and wastes pipework in conjunction with all other services. He shall ensure that all opes line up vertically and are fully co-ordinated with drainage from manholes, etc.

The Contractor shall include for the connection to builders up stands at ground floor level and complete installation of soils and wastes as detailed on the drawings. The Contractor shall include for extending all soils and waste pipework to toilets including final connections and waste traps.

4.2 Soil Pipework

All internal soil pipework above first floor level shall be U. P.V.C. supplied; by Marley to B.S. 4514, 2001 including all bends, branches, Boss branches and adapters. All pipework connections shall be ring seal joints allowing an expansion gap where necessary. The requirement of Marley regarding installation of ring seal joints shall be clearly and fully adhered to.

This Contractor shall include for all pipework fittings, cleaning doors, access points, etc. All vents from soil system shall be carried to 600mm above roof level, terminating in a suitable vent cap and bird guard. This Contractor shall provide all necessary weathering collars and aprons to the manufacturer's specification.

The Contractor shall include for all pipework supports to comply with B.S. EN 12056 and the manufacturer's requirements.

This Contractor shall demonstrate to the Engineers the stability and rigidity of the entire system prior to testing. Pipework support shall be the Marley pipe support system in zinc electro plated mild steel system.

Adequate provision for rodding and cleaning shall be provided on all pipe runs whether indicated or not.

The contractor shall include for the supply and installation of all pipework associated with kitchen sink wastes, toilet sanitary fixture wastes, CWS tank overflows and WCs overflows.

The soils and waste sanitary systems shall be of a twin stack fully ventilated type. The soils and waste pipes from each sanitary fitting shall be ventilated.

Bottle traps with 75mm seal shall be provided on the outlets of all sanitary fittings connected to the waste pipes.

All cold water storage tank and WC overflow pipes to be installed with Legionella arrestors.

Soils and wastes pipework shall be installed strictly in accordance with the manufacturer's instructions with particular reference to pipe fixing, fixing centres and provision for expansion.

Cleaning Eyes and access doors for maintenance shall be provided at every change in direction.

Tee connection with cleaning door shall be provided at each W.C. connection to the main soil pipe.

All soils & waste services pipework shall be tested to 38mm water gauge and held air tight at this pressure for a duration of 3 minutes. The tests shall be only considered valid if witnessed by the Engineer or Client representative and certified accordingly.

All sanitary fittings shall be tested and verified for adequate waste water flow and soils vent air flow prior to handover.

4.3 Grease Filters

The contractor shall include supply and installation of automatic grease removal. Unit shall feature automatic grease and oil removal, corrosion-resistant construction, sanitary stainless steel exterior, integrated odour protection and easy maintenance access. Unit sizing and installation shall be in accordance with manufacturer's recommendations.

4.4 Fittings and Ancillaries

The Contractor shall include for all pipework fittings, cleaning doors, access points etc. All vents shall be extended to roof level and shall terminate 600mm above roof level terminating in a Marley vent cap and Birdguard. The Contractor shall provide all necessary weathering collars and aprons to the manufacturer's specification. The Contractor shall include for all pipework supports to comply with B.S. EN 12056.

4.5 Fire Collars

The Contractor shall include for supply and installation of all fire collars on all soils and wastes pipework 50mm diameter and above where they pass from fire compartment to fire compartment on horizontal and vertical runs. All fire collars shall be of Marley manufacture in accordance with B.S. 476, Part 20, 1987 and shall be installed strictly in accordance with the manufacturer's requirements. All collars shall be suitable for bolting and sealing to the slab.

All fire collars shall carry a CE marking. The Contractor shall refer to the fire cert drawings to quantify the exact number of fire collars required.

5 **WATER SERVICES**

5.1 **Introduction**

Under this section the Contractor shall include for the supply and installation of the following services;

- Water services pipework
- Thermostatic mixing valves
- Equipment labelling
- Testing and commissioning.

5.2 **Water Services Pipework**

The domestic water services installations shall comprise brazed copper pipework throughout the building.

The primary source of heat for the domestic hot water shall be provided local point of use water heaters.

All pipework shall be stored clear of the ground and shall be suitably protected from the weather. Screwed end of tubes shall be protected with a socket or plastic thimble.

All pipework fittings and joints shall be of the capillary type. Threaded or flanged joints shall only be allowed where required for connecting to piping accessories, equipment, etc. No compression fittings shall be used.

All thermostatically mixed water supplies shall have a maximum pipe length of 0.3m from thermostatic mixing valve to outlet connection.

All hot water supplies shall have a maximum 'dead leg' pipe length of 0.3m from hot water service return connection to outlet connection.

All solders shall be tin/ copper or tin/ silver based. No lead composites shall be used.

It shall be the responsibility of the Contractor to ensure that all supports are adequate, firmly and truly fixed and that they do not promote vibration.

Brackets or supports shall be set out so that they do not obstruct the access to valves, flanges other fittings requiring maintenance.

Where pipes pass through walls, floors, footings and waterproof membranes, the Contractor shall provide sleeves.

Sleeves in bearing walls or footings shall be cast iron pipe.

The Contractor shall ensure that hot and cold water supply pressures are balanced at all outlets.

All water services pipework shall be tested to 700 kPa and held droptight at this pressure for a duration of 1 hour. The tests shall be only considered valid if witnessed by the Engineer or Client representative and certified accordingly.

All hot and cold water outlets shall be tested and verified for adequate water pressure prior to handover.

All hot water outlets shall be tested to ensure availability of correct water temperature and each hot water return leg shall be proven prior to handover.

The system shall be tested to 6 Bar for a minimum duration of 24 hours to confirm that a stabilised minimum pressure of 3 Bar is held in the system.

5.2.1 Insulation and Cladding

All concealed water services pipework, valves and fittings shall be insulated with preformed rigid glass fibre sections containing water repellent additives. The sections shall be supplied with a factory applied facing of reinforced aluminium foil incorporating self-adhesive overlap for fixing.

The mineral wool insulation shall be non-combustible. The aluminium foil covering shall be rated 'Class O' in accordance with the Building Regulations Part B.

The insulation shall achieve a thermal conductivity of 0.043W/m.K. The aluminium foil covering shall achieve a maximum vapour permeance of 0.00024g/s.MN.

All insulation fixing shall be in accordance with manufacturer's instructions, by peeling protective tape from self-adhesive lap and pressing lap smoothly over joint. Where adjacent sections abut, approved 75mm wide aluminium tape shall be used to maintain integrity of the vapour barrier.

All pipework installed externally shall be clad. Cladding shall be not less than 0.8mm aluminium sheeting or stucco embossed profile cladding.

Pipework shall remain uninsulated until satisfactory completion of all hydraulic tests.

All valves and accessories within all plant room areas shall be insulated to the same thickness specified for the pipeline.

Upon completion of all insulation works the contractor shall provide identifying markers and laminated valve identity tags to each and every service, whether insulated or not, in accordance with C.I.B.S.E. Codes of Practice.

Identity tag numbers shall be unique to the designated service and cross-referenced for function and use etc. to local and permanently fixed laminated valve schedules and associated diagrammatic pipeline layouts. The precise locations for same shall be agreed with the consulting engineers prior to installation.

5.2.2 Pipe Supports

All pipe supports, hangers and brackets required to support and control the movement of pipework shall be supplied and erected by the Contractor and shall be fixed to the building structure independent of plant and equipment. The Contractor shall obtain the approval of the Engineer of the type and spacing of the supports, hangers and brackets prior to erection.

5.3 Thermostatic Mixing Taps for WHBs

Unless otherwise indicated, thermostatically operated mixing valves shall be of bronze or brass construction with chromium plated finish and shall be equipped with a back-plate for wall fixing.

The thermostatic mixing valve shall comply with the following standards:

- TMV3 – Thermostatic mixing valve scheme approved for LP-T44 & LP-T46
- BS EN 1111 & BS EN 1287 – European Standard for Thermostatic Mixing Valves.

Each mixing valve shall have a control thermostat capable of providing a constant mixed water temperature under the available hot and cold water pressures and of closing down the hot water inlet within 5 seconds in the event of the cold water failing.

Each mixing valve shall be provided with a temperature regulating handle or knob permitting regulation of the mixed water up to a maximum of 45°C. Means shall be provided for varying the maximum settings and these shall be tamperproof. The valves shall also have provision for controlling the maximum rate of outlet flow. An isolating valve and strainer shall be provided on the hot and on the cold supply to each mixing valve.

5.4 Pressure Reducing Valves

The Contractor shall supply and install pressure reducing valves in the locations indicated on the drawings. Pressure reducing valves shall suitable for hot water services. All units to be supplied "Unset". All pressure adjustments to be carried out on site during testing and commissioning.

5.5 Fittings

All isolating valves shall be brass gate valves manufactured in accordance with BS5154/B PN16. Isolating valves shall be temperature rated to operate from -10°C to 120°C. Isolating valves shall be handwheel or lockshield pattern. All valves to be fitted with female sockets for bronze welding or approved compression type unions for use with light gauge copper as applicable. All valves shall be clearly marked with manufacturer's name, material designation, pressure rating, size and directional flow.

All check valves 50mm diameter and under shall be bronze manufactured in accordance with BS5154 PN20. Check valves shall be temperature rated to operate from -10°C to 120°C. Check valves shall be swing or lift type as required by installed position on. All valves to be fitted with female sockets for bronze welding or approved compression type unions for use with light gauge copper as applicable. All valves shall be clearly marked with manufacturer's name, material designation, pressure rating, size and directional flow.

All check valves 65mm diameter and above shall be flanged cast iron swing type to PN16. Check valves shall be temperature rated to operate from -10°C to 120°C. Swing check valves shall be installed in a horizontal position or where this is not possible in the vertical so that the valve will close under zero-flow conditions. All valves shall be clearly marked with manufacturer's name, material designation, pressure rating, size and directional flow.

All automatic air vents shall be constructed of stainless steel with a solid polypropylene float not mechanically coupled to the air release valve. The valve shall be spring loaded to ensure positive shut off and shall be guaranteed for at least 3 years against leakage. All automatic air vents shall be pressure rated to 10 bar at maximum operating temperature of 130°C.

All temperature gauges shall be of the vapour pressure type with brass case, straight stem, 100mm diameter dial with chrome plated bezel and complete with 100mm pocket. Temperature gauge range shall be 0°C -120°C with an accuracy of +/- 1.5% of the effective range.

All pressure gauges to be of the vapour pressure type with 100mm diam. dial. Pressure gauge range shall be to suit the application with the normal operating pressure falling towards the mid-point of the range with an accuracy of +/- 1% of the effective range.

6 GAS SERVICES

6.1 Introduction

The Contractor shall include for the supply and installation of the following gas services:

- External Distribution pipework
- Internal Distribution pipework
- Gas Detection System
- Gas Pressure Proving System

The Contractor shall be responsible for the design, supply, installation, commissioning and demonstration of the complete Gas Services systems.

All works related to the gas installation shall be carried out by a Registered Gas Installer (RGI).

The Contractor shall be responsible for the performance of the finished Gas systems.

The Gas Services systems installations shall comply with all relevant standards (IS, BS & EU), as well as best industry practice. It shall be responsibility of the contractor to demonstrate compliance with all relevant standards.

The gas supply to the building shall be natural gas.

6.2 Standards

The following standards shall apply throughout. The Contractor shall be deemed to be familiar with all relevant aspects of these standards in relation to the installation of Gas services.

- I.S. 820, Non-domestic Gas Installations.
- I.S. 265, Installation of Gas Services Pipes.
- I.S. 813, Domestic Gas Installations.
- ETCI rules, National rules for Electrical Installations (ET 101).
- I.S. EN 331, Manually Operated Ball Valves and Closed Bottom Taper Plug Valves for Gas Installations for Buildings.
- I.S. EN 751, Sealing Materials for Metallic Threaded Joints in Contact with 1st, 2nd and 3rd Family Gases and Hot Water.
- I.S. EN 751-3, Sealing Materials for Metallic Threaded Joints in Contact with 1st, 2nd and 3rd Family Gases and Hot Water – Part 3: Unsintered PTFE tapes.
- I.S. EN 1443, Chimneys – General Requirements.
- PrEN 1555-3, Plastic Piping Systems for Gaseous Fuels Supply – Polyethylene (PE) – Part 3: Fittings.
- I.S. EN 1775, Gas supply – Gas Pipework for Buildings – Maximum Operating Pressure < 5 bar – Functional Recommendations.
- PrEN 10226-1, Pipe Threads where Pressure Tight Joints are made on the Threads – Part 1: Designation, dimensions and tolerances.
- PrEN 12007, General Functional Requirements for the Materials, Design, Construction, Operation, Maintenance and Renovation of Gas Supply Systems up to and including 16 bar.
- BS 1710, Specification for Identification of Pipelines and Services.
- BS 7786, Specification for Unsintered PTFE Tape. General Requirements.

6.3 Gas Distribution Pipework

The Contractor shall include for the supply and installation of the following distribution pipework:

- Carbon steel pipework from the gas entry point to the hot water boiler and kitchen equipment
- Polyethylene (PE) (approved by Bord Gáis) from gas meter cabinet to each retail unit.
Pipework to terminate externally in lockable regulating valve.

All gas distribution pipework shall be installed strictly in accordance with I.S. 820 I.S. EN 1775, Gas supply – Gas pipework for buildings. All incoming gas services entering the building through walls and floors shall be sleeved.

All above ground gas pipework shall be heavy grade carbon steel tube to BS EN 10216-1:2002 &, BS EN 10217-1:2002 ERW between the meter position and the main isolating valve at the boiler.

All below ground gas pipework shall be polyethylene pipework to IS 266.

All below ground pipework up to 22mm passing from the meter to the entry point in the building shall be continuous copper pipework to BS2871 table X or table Y covered with corrosion resistant material and shall be installed within a PVC pipe sleeve.

6.4 Gas Detection System

The Contractor shall allow for the supply and installation of a gas detection system as indicated on the drawings.

The gas detection system shall strictly be in accordance with BS EN 50014 1993.

The system shall comprise a Motor Control Centre, gas sniffers, slam shut valve and strobe lights. The Motor Control Centres shall provide a volt free alarm output for monitoring by the fire alarm and /or BMS system.

The gas detection system shall be a Medem Two Channel unit as supplied by Modern Plant. It shall be a 0-100% LEL gas detection system complete with A1 and A2 fault relays (230V AC, 3 Amp). It shall be a Microprocessor controller, menu assisted and fully user programmable. Features shall include alarm set points, relay options and calibration mode, advanced digital readout, alarm inhibit in calibration mode, extensive fault detection firmware and battery back-up.

The Contractor shall include for labelling all gas sniffers, slam shut valves, isolating valves etc. and for cross-referencing them to As-installed drawings.

6.5 Gas Pressure Proving System

The Contractor shall allow for the supply and installation a Gas supply isolating, pressure drop point and ventilation interlock system to the kitchen areas receiving a gas supply.

The unit is to consist of a Gas Pressure-Proving Valve comprising of Dirt Trap, Main Gas Solenoid Valve; By-Pass Solenoid Valve, By-Pass Orifice and Pressure Switch 230 V supply. The valve will be controlled by a switch box comprising of a key-operated main switch, white 'power-on' indicator light, green gas test button, green 'gas on; indicator light and red emergency push button lockstop and ventilation interface.

The switch box shall have the facility to be used with auxiliary twist or key-operated lockstops. The switch box shall be anti-vandal and have the operating instructions clearly displayed on the front panel.

The Contractor shall include for testing and commissioning of the system by the equipment supplier. A Commissioning Certificate shall be issued on completion with full instructions on the operation of the system.

The gas pressure-proving systems shall be to I.S. 820.

The installation shall be supervised by personnel approved by the Manufacturer.

7 LOW PRESSURE HOT WATER (LPHW) HEATING SYSTEM

7.1 Introduction

Under this section the contractor shall include for supply and installation of LPHW pipework serving radiators within the building.

7.2 LPHW Circulating Pumps and Ancillary Items

Values of the resistance to fluid flow indicated are based on the Engineer's design drawings and specified equipment. Any variations from the development of the Contractor's co-ordination and working drawings caused by changes to equipment, components, fittings, pipework layouts, pipework sizes, etc. shall be brought to the attention of the Engineer. The Contractor shall ensure that the pumps provided are capable of delivering the required fluid flow when operating against the actual total system resistance.

Unless otherwise indicated, pump duties shall be achieved with an impeller shaft speed not exceeding 1450 r.p.m., or by means of infinitely variable speed control drives where specified.

Pumps shall be installed in accordance with the manufacturer's recommendations and shall comply with the requirements of IS/EN 60335-2-51, BS 4082 and BS 5257 as applicable, or equivalent. Pumps shall be 'type' tested in accordance with ISEN 9906. Pump curves shall be submitted to indicate performance under all likely operating conditions.

Flexible connections shall be provided on the suction and discharge side of all pumps with end connections over 50 mm and elsewhere as indicated.

Each pump shall be installed with isolating valves on the inlet and outlet connections. Unless otherwise indicated, a strainer shall be fitted on the inlet connection. Where duty and standby pumps are installed a suitable spring return type check valve shall be fitted on the discharge of each pump.

Where standby pumps are indicated with automatic change-over, the change-over shall be initiated and verified by means of flow sensing devices or within pump control logic integral in the pump set.

Pressure gauges shall be installed on the suction and discharge flanges of the pump where practical or on the pipework on each side of the pump and as close as possible to the pump connections, unless otherwise indicated.

Centrifugal pumps shall be electrically driven by glandless or TEFC squirrel cage motors to IEC standards.

Heating circulating pumps shall be glandless inline twin head (duty/standby) circulating pump, suitable for pipe-supported installation with integrated electronic speed regulation for constant or variable head control.

They shall have a maximum working pressure and temperature of 6 bar and 110°C. The electrical supply shall be as indicated in accompanying schedules. They shall be of Wilo or Grundfos manufacture or equal and approved as scheduled elsewhere within this specification or on the boiler schematic drawing.

LPHW pumps shall be provided with integrated variable speed drives, c/w integral pressure transducers, and associated pressure sensors as standard. All pumps shall be capable of operating 'constant pressure/variable flow'.

All glandless pumps shall be 'A' rated (EEI <0.23) as a minimum and glanded pumps shall have a minimum energy rating of IE2 (EFF1).

All pump VSD's shall be capable of turning down to 0% of total flow/pressure, against a deadhead.

The Contractor shall include for full commissioning of all pumps, booster pump sets and pressurisation equipment. Commissioning data shall include flow rates and pressure drops for each system.

7.3 Boilerhouse Pipework

The low-pressure hot water (LPHW) pipework shall be mild steel, medium grade, to B.S. 1387, 1985. It shall be new, clean, free from defects, of even bore throughout and delivered to site with the manufacturer's protective coating undamaged. All pipework shall be welded throughout, using B.S. EN 10253 – 1; 1999, welding fittings. Particular care shall be taken to protect finishes, including timber roof trusses when welding.

All pipework in ducts shall be painted with red oxide by this Contractor. Where pipework passes through walls or floors, it shall be sleeved with metal sleeves, finishing flush with the finished wall or floor surfaces.

All pipe supports, hangers and brackets required to support and control the movement of pipework shall be supplied and erected by the Contractor and shall be fixed to the building structure independent of plant and equipment. The Contractor shall obtain the approval of the Engineer of the type and spacing of the supports, hangers and brackets prior to erection.

Pipework shall be supported adequately and in such a manner as to permit free movement due to thermal expansion and contraction. Where pipes are thermally insulated the insulation shall be carried through the support. Vapour barriers shall not be pierced or damaged.

All sharp edges and cut ends on pipe supports, brackets, etc. shall be suitably protected.

Pipework shall be supported at a change in direction unless other agreed with the Engineer. Pipework supports shall be arranged as near as possible to the joints.

In all cases where pipes pass through walls, non-load bearing partitions, floors, ceilings and footings, sleeves shall be provided and it shall be ensured that the sleeves are correctly built-in. Sleeves shall in no case be used as pipe supports, a free annular space always being provided.

All heating pipework shall be tested to 700 kPa and held drop tight at this pressure for a duration of 1 hour. The tests shall be only considered valid if witnessed by the Engineer or Client representative and certified accordingly.

All heating pipework circuits shall be balanced and set to design flow rates, utilising dynamic constant pressure balancing valves.

7.4 Distribution Pipework

The low-pressure hot water pipework shall be carbon steel, heavy grade, to B.S. 1387. It shall be new, clean, free from defects, of even bore throughout and delivered to site with the manufacturer's protective coating undamaged.

All pipework shall be jointed using Xpress press-fit jointing system or equal and approved. The jointing system shall be suitable for use with a pressurised LPHW system using carbon steel pipework. **The jointing system shall have a minimum manufacturers guarantee of 25 years. The contractor shall liaise with the manufacturer at tender stage to establish the criteria necessary to obtain the 25 year warranty, e.g. training, pipework pressures, fittings, etc.**

All pipework in ducts shall be painted with red oxide by the Contractor. Where pipework passes through walls or floors, it shall be sleeved with metal sleeves, finishing flush with the finished wall or floor surfaces.

The Contractor shall include for all recesses, supports and brackets, including supports for pipework on the timber trusses in the pitched roof etc. The Contractor shall supply and install automatic vents on all high points and drain cocks on all low points, of the pipework system, whether shown on the drawings or otherwise.

All pipework supports shall be in strict accordance with B.S. 3974.

All pipework in the boiler house, ceiling voids, low level, high level floor ducts or roof spaces, shall be welded using B.S. EN 10253 – 1; 1999 welding fittings.

7.5 Pipe Supports

All pipe supports, hangers and brackets required to support and control the movement of pipework shall be supplied and erected by the Contractor and shall be fixed to the building structure independent of plant and equipment. The Contractor shall obtain the approval of the Engineer of the type and spacing of the supports, hangers and brackets prior to erection.

Pipework shall be supported adequately and in such a manner as to permit free movement due to thermal expansion and contraction. Where pipes are thermally insulated the insulation shall be carried through the support. Vapour barriers shall not be pierced or damaged.

Pipework shall be isolated from metal unistrut support systems using an insulated material such as Unicushion.

All sharp edges and cut ends on pipe supports, brackets, etc. shall be suitably protected.

Pipework shall be supported at a change in direction unless other agreed with the Engineer. Pipework supports shall be arranged as near as possible to the joints, and the distance between pipe supports measured along straight runs shall be in accordance with manufacturer's recommendations. Pipe support spacing shall not exceed the following:-

<u>Nominal (mm)</u>	<u>Carbon Steel</u>	
	<u>Horizontal</u>	<u>Vertical</u>
15	1.8m	2.0m
18	2.1m	2.3m
22	2.4m	3.0m
28	2.4m	3.0m
35	2.7m	3.0m
42	3.0m	3.6m
54	3.0m	3.6m
76	3.0m	3.6m
89	3.6m	4.5m
108	3.6m	4.5m

7.6 Pipe Sleeves

In all cases where pipes pass through walls, non-load bearing partitions, floors, ceilings and footings, sleeves shall be provided and it shall be ensured that the sleeves are correctly built-in. Sleeves shall in no case be used as pipe supports, a free annular space always being provided.

Sleeves shall be formed from a single piece of pipe and shall project 10mm above the finished floor level but shall be flush with the underside of the floor slab. In walls they shall project approximately 5mm on either side of the finished wall surface.

Sleeves shall be fabricated from the pipeline materials, except in load bearing walls which shall be from cast iron. Sleeves shall be of pipe cuttings properly reamed, cleaned and trimmed at 90° to bore.

The sleeves shall not protrude from the face of the building fabric except when passing through waterproof building fabric where flange sleeves which protrude 100mm shall be used.

Pipework, sleeves and fire stopping shall be installed to meet the requirements of the building regulations and to the approval of the building inspector.

Inside diameter of sleeves shall be not less than 12mm larger than the outside diameter of the pipe, except where pipes pass through load-bearing walls or footings where sleeves shall be 100mm larger than the outside diameter of the pipe.

For pipes which change direction over size sleeves, the size larger than normal, shall be fitted to allow for expansion.

In occupied spaces, fit Zinc Alloy Diecast masking plates fixed with matching screws shall be fitted.

Annular space shall be caulked with an intumescent materials or similar suitable materials.

The thermal movement shall not be impeded by the sleeve, caulking or masking plate.

Chilled water and cold water pipework shall be proved with sleeves of such size as to allow the thermal insulation, at full thickness, to pass through whilst maintaining the continuous Vapour Seal. The type of insulation shall become mineral wool with Vapour Seal for the thickness of the wall.

The Main Building Contractor shall build in the sleeves but it will be the responsibility of this Contractor to ensure that they are correctly located.

7.7 Insulation and Cladding

The Contractor shall include for insulating all heating pipework, either exposed at high level, concealed in suspended ceiling voids, or carried, exposed in pitched roof spaces, and in underfloor pipe ducts.

All heating pipework, except where exposed at low level, or where dropping to low level, shall be fully insulated and shall comply with Technical Services Document Building Regulations providing a thermal conductivity of not greater than 0.035 w/mK. Pipe work insulation shall comply with B.S. 5422, 2001 & BS EN ISO 12241: 1998. All pipe work insulation shall be Class 0 fire rated.

The pipework insulation shall be comprise of rigid preformed pipe sections, wrapped in factory applied reinforced aluminium foil laminate complete with integral self-adhesive lap and light gauge aluminium bands at not more than 450mm centres. Pipework insulation shall be 25mm for pipes up to 35mm and 30mm for pipes up to 54mm.

The Contractor shall ensure that all surfaces are clean and dry before insulation is applied. The insulation shall be dry before and during application.

All piping and equipment shall be tested and approved before insulation.

Insulation thickness shall be as follows: -

- Up to 19mm dia. 25mm thick insulation
- 25mm dia. to 32mm dia. 25mm thick insulation

- | | |
|--------------------------|-----------------------|
| • 38mm dia. to 50mm dia. | 32mm thick insulation |
| • Over 50mm dia. | 40mm thick insulation |

7.8 Insulation of Valves and Flanges

Within plant rooms, boilerhouses, other viewable areas within buildings and external to buildings, valves and flanges are to be enclosed in purpose made two piece boxes, hinged on one side and secured with quick release fasteners on the opening side. Type of metal to match cladding on adjacent insulated pipework.

Boxes are to be lined within insulation to match type and thickness of that on adjacent pipework, boxes fitted to external fittings are to be designed to be weatherproof.

Valves and flanges within ceiling voids and other hidden areas shall be enclosed in purpose made covers, comprising mineral wool blanket, sandwiched within glass fabric coated with silicone rubber. The covers are to be demountable and shall be secured by 'Velcro pads' or nylon pull cords.

7.9 Commissioning Sets and Balancing Valves

Under this section the contractor shall include for the supply and installation of commissioning sets and balancing valves as required to enable complete commissioning of the entire heating system.

The Contractor shall supply, install and commission double regulating balancing valves at each motorised valve position and elsewhere as indicated on the drawings and as necessary to ensure the proper running of the heating systems.

Double regulating valves shall be of Tour & Anderson manufacture and of the following types;

- | | |
|-----------------------|------|
| • Up to 65mm diameter | MD41 |
| • 80mm and larger | MD54 |

For accurate measurement of the system the minimum distance of straight shall be 10 times the pipe diameter upstream to the flow measuring device and 5 times the pipe diameter downstream of the flow-measuring device to prevent false readings due to turbulence.

A gate valve shall be installed on the flow and return at each commissioning set location for isolation purposes.

Regulating valves, orifice units and commissioning sets shall be fitted with Binder Twinlock test plugs.

The manufacturing tolerances shall ensure a main flow rate of water within +/- 5% of a given pressure differential measurement on a manometer. Commissioning sets shall be selected against their relative flow rate to ensure that the minimum pressure signal as recommended by the valve manufacturer is obtained to ensure accurate readings.

7.10 Dynamic Pressure Independent Control Valves

Dynamic Pressure Independent Control Valves shall be electronic, dynamic, modulating 2-way control devices. They shall accurately control flow, independent of system pressure fluctuation.

Maximum flow setting shall be adjustable to a minimum of 50 different settings with the range of the valve size. Valve actuator housing to be rated to IP 44.

Actuator shall be operated by a 24V DC motor, and shall accept 2-10V DC, 4-20mA, 3-point floating or pulse width modulation electric signal and shall include a resistor to facilitate any of these signals.

External LED readout of current valve position and maximum valve position setting shall be available.

Valve housing for valve sizes 15-40mm shall be constructed of forged ASTM (CuZn39Pb2) brass rated at no less than 2500kPa static pressure and 120°C.

Valve housing for valve sizes 50-150mm shall be constructed of Ductile Iron ASTM A536-65T, Class 60-45-18 rated at no less than 4000kPa static pressure and 120°C.

Valve housing shall be double union construction with a range of pipe connections available for the appropriate pipe size.

Optional dual pressure/temperature test plugs for verifying accuracy of flow performance shall be available for all valve sizes.

Flow regulation unit shall consist of stainless steel and hydrogenated acrylonitrile butadiene rubber and shall be capable of controlling flow within +/- 5% of each rated flow.

Flow regulation unit shall be accessible, for maintenance.

The Mechanical Contractor shall provide a numeric tag for each pressure independent control valve to allow for random testing of design flow temperature and pressure. Tags shall be of aluminium material and 50mm x 25mm in size indicating number, production date and pressure differential range.

7.11 Isolation and Regulation

Valves, cocks and stop taps for isolation and/or regulation shall be provided where shown in the drawings and on the mains to isolate major sections of distribution, on the base of all risers and droppers except in cases, where one item of apparatus only is served which has its own local valve or stop tap, on all sub-circuits of closed systems, on points of pipe connection of all items of apparatus and equipment except where the item could conveniently be isolated or regulated by valves provided for other adjacent items and on draw-off fittings except where ranges of fittings are served by a common float, the isolator then being fitted with the float.

7.12 Commissioning Points

'Binder' type tappings for commissioning purposes shall be provided, numbers and locations to be agreed with Engineer.

Generally self-sealing test points shall be provided on all secondary headers, heating and cooling piping main branches, each port of each automatic control valve, inlet and outlet of each heater and cooler battery or terminal unit, and entry and exit from each plant room heating and chilled water service.

Test points shall be mounted on the side of pipes and shall be dual purpose for pressure gauge and thermometer, and shall repeatedly reseal.

7.13 Automatic Air Eliminators

Bronze automatic air eliminators shall be used with integral lockshield valve on inlet and check valve on outlet, manufactured to facilitate grit removal whilst in service.

Screwed female connections shall be provided on pipelines of all sizes.

Integral 10mm hard soldered copper discharge pipeline shall be provided.

Air release pipes shall be run to discharge at the nearest suitable visible safe point.

7.14 Drains

Drain cocks, not less than 15 mm, with hose connections, shall be fitted at low points in the pipework distribution systems and local to items of equipment and headers.

Drain valves shall be fitted to common flow and common return lines and shall be of the same size as the largest pipe size of any sub-circuit.

Drain valves, shall be fitted to facilitate flushing and cleaning of pipework where indicated on the drawings and where required. Drain valves shall be bronze lockshield globe or gate valves to BS 5154, with hose union connector.

Drain valves or cocks shall be lockable except where prohibited by the local water authority.

7.15 Tundishes

Tundishes shall be fabricated from 3m thick mild steel plate, to give a large end diameter of 100mm and a small end diameter of 25mm with an included apex angle of 30 degrees. Weld a 25mm female screwed boss to the small end galvanised after manufacture.

Pressure relief or combined pressured and temperature relief pattern valves shall be used to the appropriate British Standards.

Safety valves for boilers, heating calorifiers and all pressure vessels shall be provided irrespective of whether shown on the drawings or not.

Safety valves for steam, HTHW and MTHW shall be as indicated on the drawings and the Specification.

7.16 By-Passes

Fixed by-passes shall be provided around all items of plant, equipment or ancillaries which may be subject to damage during flushing or testing and commissioning.

7.17 Vibration Isolation

All dynamic machinery shall be isolated from the building structure by vibration isolators and/or vibration isolation materials which shall be purpose designed and selected to suit the machinery.

Where mat type isolation materials are used the Contractor shall supply the materials and be responsible for their correct location; all other vibration isolators shall be supplied and installed by the Contractor.

For fans and air distribution systems flexible joints shall be provided to minimise the transmission of vibration. For pumps and water distribution systems, purpose-designed flexible connections shall be provided to minimise the transmission of vibration. The connections shall be compatible with the tube materials and methods of jointing and the fluid handled in the system.

7.18 Expansion bellows

The expansion bellows shall be provided to absorb the movement of the pipelines as fabricated by one of the scheduled firms to BS 6129 and ensure compatibility with the pipeline service and materials. When installing manufactured expansion loops or bellow joints, the manufacturer's installation recommendations shall be observed in every respect.

On Low Pressure systems single wall, convoluted, stainless steel bellows with internal sleeves shall be used, and screwed or welded connections up to 50mm or flanged connections over 50mm

On Medium or High pressure systems single wall, convoluted, stainless steel bellows with internal and external sleeves shall be used, and screwed connections up to 50mm or flanged connections over 50mm

On Secondary Low pressure systems single wall, convoluted, stainless steel bellows with internal and external sleeves shall be used, and screwed connections up to 50mm or flanged connections over 50mm

The expansion bellows shall be installed with great care to ensure no misalignment of the bolt holes and mating flanges and ensure that heat from welding process does not affect bellow materials.

Pre-stress shall only be in accordance with the manufacturer's instructions. Before expansion load is applied any temporary installation bars shall be removed.

When pressure testing pipework distribution it shall be ensured that the test pressure will not damage the bellows, anchor points, guides and the building structure. Spacer pieces shall be fitted in place of bellows, during any pipeline testing which may affect bellows.

8 **RADIANT PANELS**

8.1 **Introduction**

The Contractor shall include for the supply and installation of all radiant panels as indicated on the drawings and as scheduled elsewhere within this specification.

8.2 **Radiant Panels**

The radiant panels shall be the horizontal steel panel type. They shall be of the size and output as detailed in the accompanying Equipment Schedule.

Each radiant panel or shall be complete with an isolating valve with hand wheel on the flow connection and lockshield valve on the return connection.

Each Radiant Panel shall be provided with flow and return Radiant Panel valves. A recessed key operated air vent and suspension chains or installation frames where mounted in plastered ceilings.

Radiant Panels shall comprise rigid uniform units of welded construction completely free from sharp or burred edges, with screwed connections for valves and air cocks. Radiant Panels having a perceptible degree of distortion will not be accepted and all units shall conform to the requirements of BS 3528.

Radiant Panels shall be manufactured in accordance with the requirements of BS EN 442 and shall be of a robust quality from cold rolled steel plate with a minimum standard wall thickness of 1.5mm. All shall can withstand a static head of 3.5 bar. Each Radiant Panel shall be supported by the manufacturer's purpose made brackets. Commissioning data shall include for measured water flow rates to each individual emitter.

Radiant Panels shall be supplied with powder coated RAL 9010 white finish as standard. **Radiant Panels shall have a minimum manufacturer's warranty of 5 years.**

8.3 **Radiant Panel Valves**

Each Radiant Panel shall be provided with a volume flow control valve on the flow inlet and a lockshield valve on the return outlet.

8.4 **Testing**

The system shall be tested to 6 Bar for a minimum duration of 24 hours to confirm that a stabilised minimum pressure of 3 Bar is held in the system.

9 HEATER BATTERIES

9.1 Introduction

The Contractor shall include for the supply and installation of the heater batteries as indicated on the drawings.

9.2 Heater batteries

The Contractor shall include for the supply and installation of all radiators as indicated on the drawings.

All radiators shall be complete with recessed air vents and concealed wall brackets or with floor brackets where scheduled.

All radiator dimensions shall be checked on site prior to ordering to ensure that they can be accommodated within the space provided. Radiators shall be mounted at a minimum of 150mm above floor level for concealed pipework and 250mm above floor level for exposed pipework.

Each radiator shall be supplied powder-coated RAL 9010 white finish as standard with a tube thickness of 1.6mm.

Below is a generic clause you can adapt into a mechanical specification. It is written so that the project-specific performance data sits in the schedules.

9.3 LPHW Duct Heater Batteries

Provide low pressure hot water (LPHW) heater batteries for installation within supply air ductwork at the locations indicated on the drawings and schedules.

Heater batteries shall be purpose-designed for duct installation and selected to provide the scheduled heating duty at the scheduled air and water conditions. Units shall be suitable for continuous operation within the specified system operating conditions.

Heating capacity, air volume, entering and leaving air temperatures, LPHW flow and return temperatures, water flow rate, maximum air-side pressure drop, maximum water-side pressure drop, connection sizes and other project-specific requirements shall be as indicated in the schedules.

9.4 Construction

Heater batteries shall comprise seamless copper tubes mechanically expanded into continuous aluminium plate fins, unless otherwise stated in the schedules. Tubes, fins and tube spacing shall be selected to provide the specified performance without excessive air resistance.

Headers and connections shall be suitable for the scheduled LPHW system and operating pressure. Connections shall be arranged to facilitate correct piping installation, venting, draining and removal of the battery.

Provide air vents at high points and drain connections at low points where these are not incorporated within the adjoining pipework.

The complete battery shall be adequately supported within a rigid, corrosion-resistant casing suitable for installation between duct sections. Casing construction and finish shall be appropriate to the environmental conditions and compatible with the adjoining ductwork.

Provide flanged or otherwise approved duct connections compatible with the specified ductwork system.

All materials in contact with the system water shall be compatible with the materials used throughout the LPHW installation and with the specified water-treatment regime.

9.5 Performance and Selection

Select each heater battery on the basis of the scheduled entering air condition, leaving air condition, air volume, LPHW flow and return temperatures and available water pressure.

The battery shall achieve not less than the scheduled sensible heating duty under the specified design conditions.

Air velocity through the battery and fin spacing shall be selected to provide satisfactory heat transfer while limiting fouling and air-side resistance.

Air-side and water-side pressure drops shall not exceed the values stated in the schedules.

Manufacturer's selection data shall be based on certified or independently verified performance data and shall be submitted for review prior to manufacture.

Where the scheduled duty cannot be achieved within the specified pressure-drop limitations, notify the Contract Administrator/Engineer before manufacture and provide revised selection data for review.

9.6 Pressure Rating and Testing

Coils, headers and connections shall be suitable for the maximum working pressure and temperature of the LPHW system.

The manufacturer's pressure rating shall provide an adequate margin above the system design working pressure.

Each battery shall be factory pressure tested for leakage and structural integrity in accordance with the manufacturer's standard procedures and applicable standards. Provide test certification when requested.

9.7 Installation

Install heater batteries in accordance with the manufacturer's recommendations and in the orientation upon which the manufacturer's selection is based.

Arrange batteries to provide uniform airflow across the complete face area. Duct transitions immediately upstream and downstream shall be configured to avoid significant maldistribution of airflow.

Provide adequate permanent access for inspection, cleaning, venting, draining and maintenance.

Where practicable, arrange the installation so that the complete battery can be withdrawn without dismantling major items of plant or permanent building fabric. Provide removable duct sections, access panels or equivalent provisions where required.

Support the battery independently where its weight cannot be adequately carried by the ductwork system.

Seal connections between the battery casing and adjoining ductwork to the same air-leakage standard as the associated ductwork.

9.8 Pipework Connections

Connect batteries to the LPHW system in accordance with the drawings and schematics.

Arrange flow and return connections in accordance with the coil manufacturer's requirements to achieve the scheduled performance and effective air removal.

Provide isolating valves to permit removal of the battery without draining the complete system.

Provide regulating/balancing facilities where required by the specified hydronic balancing system.

Provide control valves, actuators, strainers, commissioning valves, pressure/temperature test points and associated accessories as indicated on the schematics, schedules and control specification.

Pipework connections shall not impose undue loads or stresses upon the battery headers or connections.

9.9 Control

Control the LPHW flow through the heater battery using the control valve arrangement indicated on the schematics and controls specification.

Control valves and actuators shall be selected to provide stable control throughout the required operating range and shall be coordinated with the BMS/control system.

The heater battery, control valve and associated system shall be capable of maintaining the scheduled supply-air temperature under design operating conditions.

9.10 Frost Protection

Where a heater battery is subject to a risk of freezing, provide frost protection in accordance with the controls specification and system schematic.

Frost protection measures may include low-temperature detection, control-valve override, pump operation, fan shutdown, outside-air damper closure and/or other measures appropriate to the system arrangement.

The controls sequence shall take priority over normal temperature control when a frost condition is detected.

The installation shall be arranged to permit complete draining of the battery where required.

9.11 Corrosion Protection

Protect ferrous components against corrosion. Factory-applied finishes shall be suitable for the environmental conditions in which the battery is installed.

Where batteries are exposed to corrosive or aggressive air streams, provide enhanced tube, fin and/or casing protection where specified in the schedules.

9.12 Submittals

Submit manufacturer's technical data for each heater battery including dimensions, weight, construction materials, tube and fin configuration, connection details, heating capacity, air volume,

entering and leaving air temperatures, water temperatures and flow rate, air-side pressure drop, water-side pressure drop and maximum working pressure.

Provide certified performance data and manufacturer's installation and maintenance requirements.

9.13 **Commissioning**

As part of the commissioning process the contractor shall flush and clean the associated LPHW pipework before placing the heater battery into service. Vent the battery and confirm that it is completely filled with water. Balance the water flow to the scheduled value and record the final commissioned flow rate. Verify operation of the control valve and actuator and demonstrate correct response to the BMS/control system.

The contractor shall also measure and record relevant entering and leaving air temperatures and water temperatures and confirm satisfactory operation at the available system conditions. Test frost-protection functions, where provided, and demonstrate the complete control sequence. The above information should be included with the final settings, measured values and test results within the commissioning records and O&M documentation

10 **VENTILATION DUCTWORK AND FITTINGS**

10.1 **Introduction**

Under this section the contractor shall include for the supply and installation of the following services;

- Ductwork and fittings
- Diffusers and grilles
- Volume control dampers
- Fire Smoke Dampers.

10.2 **Ductwork and fittings**

The Contractor shall include for the supply and installation of all galvanised steel metal ductwork for supply and exhaust systems, as indicated on the drawings.

Under no circumstances shall asbestos based gaskets or jointing materials be used in any section of the ductwork or equipment, directly or indirectly in contact with the air supply or extract systems.

All ductwork systems shall be carried out by approved Contractors regularly engaged in similar work. The Contractor must specify the sub-contractors to provide ductwork services prior to commencement on site.

All ductwork shall comply with the latest editions of the following HVAC publications with additions and amendments as required by this specification and elsewhere in the documents:

- DW/144 Specification for Sheet Metal Ductwork.
- DW/154 Specification for Plastic Ductwork.

Typical ductwork fabrication drawings shall be submitted for comment prior to the manufacture of ductwork.

Rigid ductwork shall be hot dipped galvanised sheet to BS EN 10143:1993, Grade Z2.

All ductwork, rectangular and circular, shall comply with the requirements of DW/144 with regard to sheet thickness, longitudinal seams and stiffeners, for each ductwork classification, i.e. low, medium or high pressure.

All ductwork supports shall be in accordance with DW 144 and shall take into consideration all other services. The Contractor shall install a strip of anti-vibration material between each support and ductwork. This strip shall be Neoprene rubber or equal and approved.

The Contractor shall include for turning vanes and splitters in all bends, tees, etc. as detailed in accordance with DW/144.

Full details of all supports shall be provided including proposals for fixing to the building fabric of concrete and steelwork.

10.3 **Flexible Ductwork**

Flexible ductwork shall be installed between all items of equipment and rigid ductwork such as grilles and diffuser. Flexible ductwork shall be kept to a maximum length of 500 mm and shall not be used to change direction unless indicated or approved by the Engineer.

The internal diameter of flexible ductwork shall be equal to the external diameter of the rigid duct or equipment it is connecting to. Flexible ductwork shall be in accordance with DW/144.

10.4 **Volume Control Dampers**

The Contractor shall supply and install multileaf type volume control dampers complete with spindle extended outside the ductwork and have extended spindles where required to allow for insulation, which shall connect to an adjusting handle with calibrated full quadrant locking devices which shall have continuous adjustment between the open and closed positions. When the handle is locked the damper blades shall be held rigidly in the air stream without play.

The dampers shall be sized to suit the extent of control required to balance systems. Volume control dampers shall be in accordance with DW/144.

10.5 **Access Opening**

Access openings shall be provided as stated in DW144 to level 3 of table 25 (cleaning access panels) except if stated elsewhere.

All access openings shall be purpose made units and shall be rigidly framed and fitted with airtight covers so designed as to be simply and speedily removed and re-fixed without the use of tools. Multiple set screws or self-tapping screws shall not be used as a method of fixing.

Access doors and other opening in ductwork shall be provided for the purposes given below

Access for personnel for maintenance and replacement of plant items.

Access for routine maintenance, lubrication and adjustment of items not requiring full man access.

Access for cleaning (e.g. at base of riser ducts for removal of construction debris).

Access for inspection of items concealed in ductwork (e.g. automatic and manual dampers, fire dampers, fusible links, orifice plates, thermostats etc). Hand holes required to permit proper jointing of ductwork sections in awkward locations (these should be kept to a minimum and as small as practicable).

Test holes to permit entry of pilot tubes and other test equipment.

10.6 **Removable Access Cover**

Removable access covers shall be not less than 300 x 300mm on ductwork or relevant side or diameter of 450mm or greater, and not less than 250 x 150mm on ductwork or relevant side or diameter of less than 450mm. They may require enlarged access opening to be formed on the duct.

Access covers shall not be larger than 375mm x 300mm unless essential for access to equipment in which case the size shall be approved.

The openings in the duct shall be adequately reinforced and sufficiently rigid to prevent distortion. A suitable sealing gasket shall be provided with sufficient fastenings to ensure an air tight seal.

10.7 **Access Openings in Insulated Ducts**

Where ducts are to be thermally insulated the access door frame shall be extended beyond the face of the duct by a measurement equal to the thickness of the insulation and be so arranged that the insulation and finish can be "dressed" into the frame, thereby ensuring that the opening is not concealed and that the edges of the insulation are protected from accidental damage. If it is

necessary to insulate the access door, it should be dished to contain the insulation, and of double skin metal construction, of a type approved by the Engineer.

10.8 Test Holes for Instruments

These shall be provided to enable fan duties to be tested and the performance of regulating dampers to be assessed. All holes shall be 10, 15 or 25mm diameter dependent upon test instruments and provided with an effective sealing rubber gasket or tight fit plastic/rubber grommets.

10.9 Insulation

All Extract Air ductwork exposed on the external of the building shall be insulated with 50mm glass mineral wool rigid slab of 48m³/kg nominal density Class O facing finish complete with factory applied aluminum foil, with longitudinal overlaps, all clad with aluminum sheet not less than 0.8mm thick.

Supply and Fresh air ductwork concealed in the ceilings shall be insulated with 50mm glass mineral wool rigid slab of 48m³/kg nominal density Class O facing finish complete with factory applied aluminum foil, with longitudinal overlaps.

10.10 Weatherproofing

All external Ductwork shall be insulated and weatherproofed with 1.2mm thick stucco embossed aluminium sheeting or 0.9mm thick aluzinc sheeting. Sheetting is to have minimum 50mm wide tapped joints, sealed with moisture curing silicone rubber sealant and secured with cadmium plated self-tapping screws or self-sealing 'pop' rivets at maximum 100mm centres.

Insulation for the top surface of horizontal ducts shall be factory prepared to provide a fall of 1:25. On ductwork with a width of 1 metre or below a single pitch shall be used on ductwork above 1 metre a double pitch shall be used. The minimum thickness of insulation shall be maintained including at all flanges and supports.

External services shall be weatherproofed either with a roofing felt and wire netting system, or, when mechanical damage is possible, with metal sheeting. (Mechanical damage is possible if located close to walkways or exposed to extreme weather).

Installation of sections shall be performed to fit the diameter of the pipe or underneath layer of insulation.

The sheet metal shall be formed to fit tightly over the outer circumference of the insulation with a longitudinal overlap of not less than 40mm, the outer part of the overlap to be secured with self-tapping screws or rivets of the appropriate type at centres of not more than 150mm. **Rivets or screws, which may damage the vapour barrier, are not to be used.**

Circumferential overlaps to be not less than 40mm and secured with self-tapping screws or rivets, not less than four, equally spaced. All joints shall be so arranged as to shed liquids. All joints shall be sealed with suitable gun applied water resistant sealant. All bends and fittings to be covered with matching sheet metal tailored to fit and sealed. End joints shall be covered with a 38mm wide strip and purpose made caps.

Special care should be taken to avoid electrolytic corrosion. Blind rivets or screws shall be spaced not more than 100mm apart. At the junction between performed insulating materials and fixed steelwork, the joint shall be packed with mineral fibre to accommodate differential thermal movement. The cladding shall be additionally secured with metal banding at 450mm centres. The banding shall be selected to complement the sheet cladding and not contribute to bi-metal corrosion.

The contractor shall be responsible for timing the installation of the weatherproofing to avoid any potential mechanical damage to the materials installed.

10.11 **Painting**

All ferrous materials, brackets, anchors etc shall be thoroughly wire brushed, degreased if necessary and painted on priming coat before fixing and an additional priming coat on completion before application of an undercoat.

Ferrous materials in trenches, ducts or where exposed externally, shall be covered with one coat of black bitumastic based paint after installation.

All thermal insulation to pipework or ductwork exposed to view where not protected by aluminium foil or plastic finish shall be painted with one coat of undercoat and one coat of gloss paint. Insulation concealed from view and not readily accessible shall not be painted.

10.12 **Diffusers and Grilles**

The contractor shall include for the supply and installation of supply air, return air and extract grilles as indicated on the drawings and as scheduled elsewhere within this specification.

All grilles and diffusers shall be secured with fasteners and sub-frames, to allow for quick and regular removal for cleaning and come complete with opposed blade dampers and propriety plenum / grille box.

Grille plenum boxes shall be supplied by the grille manufacturer and shall be complete with acoustic lining. The contractor shall provide a sample of the grilles and plenum box to the engineering prior to ordering.

10.13 **Connections to External Louvres and Terminals**

At all connections to louvres, the bottom of the duct shall slope down towards the opening to prevent water entering. The inside of the duct shall be coated with black bitumastic paint for a distance of not less than twice the height of the opening.

All areas of louvres which are not used as air intakes or discharges shall be blanked off with galvanised sheet which shall be suitably stiffened to prevent drumming.

Blades on external louvres shall be at 45° to the horizontal and be turned on both edges to exclude rain. Spacing shall be such as to prevent horizontal vision, the free area of louvres being to the Engineer's satisfaction with 15 mm square mesh galvanised after manufacture to form a wire bird screen shall be fixed inside the louvres with suitable access for easy cleaning.

Where connections are made to roof penetration suitable flashing shall be incorporated to prevent ingress of water. Details of flashings shall be submitted to the Architect for acceptance prior to manufacture.

10.14 **Ductline Noise Attenuation**

Ductline noise attenuation shall be manufactured by one of the preferred companies to meet the requirements of this specification.

The outer casings shall be manufactured from galvanised mild steel generally with flanged ends. On secondary units with a face area of 300 mm² or less spigot, and socket ends shall be used.

Resin bonded glass fibre or mineral wool acoustic media shall be used encased in a secure non-porous membrane capable of attaining Class 1 spread of flame when tested to BS 476.

The acoustic media on the inside face shall be supported with galvanised perforated steel mesh or other proprietary reinforcing facing.

10.15 Manometers

The Sub-Contractor shall include for all filters to be provided with manometers to indicate the differential pressure across the filter. These shall be the inclined type and dual scale calibrated 0 to 500 Pa/50 to 1200 Pa. The gauge fluid shall be blended paraffin SG 0.785 at 18°C dyed bright red. The gauge shall have zero adjustment facility incorporated in the casing.

The manometer's position shall be determined by the Engineer.

10.16 Duct Thermometers

Thermometers shall be 100mm diameter dial type located in the ductwork as generally shown on the drawings but to a minimum to measure the following:-

- Fresh Air Inlet Air Temperature
- Return Air Temperature to Air Handling Plant
- 'On Coil' Air Temperatures
- 'Off Coil' Air Temperatures
- Supply Air Temperatures (including individual zone temperatures where applicable).

The thermometers shall be type 520, with scale range -20 to 45°C. the length of stem shall be to suit two thirds of the relevant duct width up to a maximum of 600mm long.

The thermometers shall be as manufactured by Brannan Thermometers Limited, Cleator Moor, Cumberland, CA25 5QE, or equal and approved.

10.17 Ductwork Identification

The Sub-Contractor shall include for the identification of all ductwork in accordance with Appendix B of the DW/144 specification, to be carried out as detailed in Section 4.00 of this Specification.

11 **EXTRACT AND SUPPLY FANS**

11.1 **Introduction**

Under this section the contractor shall include for the supply and installation of supply and extract fans as indicated on the drawings and as scheduled elsewhere within this specification.

All fans shall be complete with a speed controller and thermistor type thermal overload device embedded in the fan motor windings.

Any variations from the development of the Contractor's co-ordination and working drawings caused by changes to equipment, components, fittings, ductwork layouts, ductwork sizes, etc. shall be brought to the attention of the Engineer.

The Contractor shall ensure that the fans provided are capable of delivering the required airflow when operating against the actual total system resistance.

Fans shall be constructed to proven design standards and shall be capable of withstanding the pressures and stresses developed during continuous operation and during speed and duty changes. Additionally, belt-driven fans shall be capable of running continuously at 110% of the selected duty speed and shall have a minimum of two belts.

The shaft and impeller assembly of all fans shall be statically and dynamically balanced to BS 5265.

The Contractor shall provide all necessary holding down bolts for fixing the equipment and shall mark out and supervise the formation of all bases and curbs as may be required.

The Contractor shall be responsible for final tuning of fan duties on site to achieve the required air flow when operating against the actual total system resistance.

11.2 **Centrifugal Fans**

Fans in air handling units shall be belt-driven double-inlet centrifugal type with a fan total efficiency of not less than 60% and 50% for backward and forward curved types respectively. The fan section shall be tested in accordance with BS 6583.

Centrifugal fans consuming more than 7.5kW at the fan shaft shall be backward curved type with aerofoil blades, selected for operation at a fan total efficiency not less than 80%.

Fan casings shall be of mild steel sheet, with welded or riveted joints and welded angle stiffeners, constructed to permit withdrawal of the fan impeller. A plugged drain shall be fitted at the lowest point in the casing. Permanent indicators shall show the direction of rotation of the impeller. Casings shall have access panels with air seals to facilitate maintenance.

Impellers shall be of mild steel protected against corrosion or aluminium alloy and shall be of bolted, riveted or welded construction.

11.3 **Axial Flow Fans**

Impellers shall be of mild steel protected against corrosion, aluminium or moulded reinforced plastics. Blades shall be of aerofoil section and, unless otherwise indicated, shall be capable of pitch adjustment.

Fan casings shall be rigidly constructed of mild steel or aluminium alloy and shall be complete with an access door, mounting feet, anti-vibration mountings, and flanged connection spigot to take flexible connectors.

For in-duct mounted fans, the length of the fan casing shall be greater than the combined length of the impeller and motor.

11.4 Passive Infra-red (PIR) Control

Where indicated fans shall be controlled by PIRs with a run-on timer facility. PIRs shall be suitable rated to control the electrical load of the fans on start-up and shall be supplied free issued to the electrical contractor for wiring up.

11.5 Wall Controllers

Where indicated fans shall be controlled by local wall controllers with speed control settings. Controller shall be suitable rated to control the electrical load of the fans on start-up and shall be supplied free issued to the electrical contractor for wiring up.

12 **KITCHEN CANOPY AND FIRE SUPPRESSION SYSTEM**

12.1 **Introduction**

Under this section the contractor shall include for the supply and installation of kitchen extract canopies with fire suppression systems as indicated on the drawings and as scheduled elsewhere within this specification.

12.2 **General**

The Contractor shall provide commercial kitchen extract canopies of the wall-mounted or island type as indicated in the equipment schedules and drawings.

Canopies shall be purpose-designed for the capture, containment, filtration and extraction of heat, grease-laden vapour, fumes and cooking effluent generated by the associated catering equipment.

Canopies shall incorporate extract ventilation, air-jet technology and low-velocity make-up/supply air within an integrated assembly. Canopy type, arrangement and nominal dimensions shall be as indicated in the schedules.

Canopies shall be Novameta HFPD wall canopy / Novameta HFCD island canopy, or technically equivalent approved, as scheduled.

The complete installation shall comply with applicable statutory requirements and recognised standards and guidance for commercial kitchen ventilation systems

12.2.1 **Canopy Type**

Where scheduled as wall type, the Contractor shall provide wall-mounted canopy generally equivalent to Novameta HFPD, incorporating extract, air jet and integrated low-velocity supply-air distribution.

Where scheduled as island type, the Contractor shall provide ceiling-suspended island canopy generally equivalent to Novameta HFCD, incorporating extract, air jet and integrated low-velocity supply-air distribution.

12.2.2 **Construction**

The Contractor shall fabricate canopy from high-quality stainless steel suitable for heavy-duty commercial kitchen use. All visible surfaces shall have a uniform brushed/satin finish unless otherwise scheduled.

Construction shall be rigid, robust and suitable for continuous operation within a commercial kitchen environment. Joints shall be continuously welded or otherwise constructed to provide smooth, hygienic and readily cleanable internal and external surfaces.

Edges, corners and exposed surfaces shall be smooth and free from sharp projections. Construction shall minimise ledges, crevices and inaccessible areas in which grease, dirt or condensate could accumulate.

The Contractor shall provide sufficient structural reinforcement for connection to the building structure independently of the associated ductwork.

The canopy and its suspension system shall support the dead weight of the complete assembly, including filters, grease collection components and integral accessories, without distortion

12.2.3 Extract System

The Contractor shall provide extract plenums and duct connection spigots/collars sized and positioned in accordance with the selected manufacturer's standard arrangement for the scheduled canopy dimensions.

The canopy shall provide uniform extraction across the effective capture area and shall be arranged to minimise localised high velocities and areas of poor capture. The extract system shall be capable of capturing and containing the cooking plume generated by the equipment beneath the canopy under the specified design operating conditions.

The Contractor shall provide suitable pressure measurement/test points within the canopy to permit measurement and fine adjustment of extract airflow during commissioning. Where required for system balancing, provide extract volume-control dampers at the canopy or associated branch ductwork.

12.2.4 Grease Filtration

The Contractor shall provide removable, high-efficiency cyclonic grease filters suitable for commercial kitchen extract applications. Filters shall be stainless steel and suitable for repeated removal, washing and replacement.

Filters shall be installed at the manufacturer's recommended angle and arranged so that grease drains safely to the grease collection system. Filter size and quantity shall be appropriate to the scheduled canopy size and selected manufacturer's model. For the specified Novameta basis of design, HFPD and HFCD canopies use high-efficiency cyclonic grease filters.

The Contractor shall provide blanking plates where necessary to prevent untreated extract air bypassing the filters. Filters shall be readily removable from below without requiring specialist tools or dismantling of the canopy.

12.2.5 Grease Collection

The Contractor shall arrange the canopy and filter bank so that grease draining from the filters is collected safely without dripping onto the cooking equipment or floor. Provide grease collection channels/gutters as an integral part of the canopy construction. Provide removable grease collection trays or containers where required by the selected canopy arrangement. All grease collection components shall be readily accessible and removable for cleaning.

12.2.6 Air-Jet System

The Contractor shall provide an integral air-jet system designed to enhance capture and containment of the thermal plume and cooking contaminants and thereby optimise the required extract airflow.

Air jets shall be distributed along the canopy in accordance with the manufacturer's design and shall be directed to support effective containment without causing unacceptable draughts at occupied level or adversely affecting gas flames or cooking processes.

The Contractor shall provide dedicated air-jet duct connection(s) sized in accordance with the selected manufacturer's standard arrangement. Air-jet airflow shall be independently adjustable and capable of being balanced during commissioning. Provide air-jet volume-control/adjustment dampers where required to achieve the manufacturer's design airflow.

Where an integral air-jet fan is selected or scheduled, the Contractor shall provide the complete fan, motor, electrical connections and controls as part of the canopy assembly. The air-jet system shall operate only when the associated kitchen extract ventilation system is enabled unless otherwise indicated by the controls specification.

12.2.7 Integrated Supply / Make-Up Air

The Contractor shall provide integral low-velocity supply/make-up air distribution through perforated canopy panels. The arrangement shall introduce supply air at sufficiently low velocity to avoid disruption of the cooking plume or reduction in canopy capture and containment performance.

The Contractor shall provide supply-air connection spigots/collars sized and positioned in accordance with the selected manufacturer's standard arrangement. Supply airflow shall be independently adjustable and capable of being balanced during commissioning. Provide supply-air volume-control dampers where required.

Supply air shall be filtered and conditioned as indicated elsewhere in the mechanical specification. The quantity and temperature of supply air delivered through the canopy shall be coordinated with the overall kitchen ventilation and comfort strategy.

12.2.8 Airflow Rates

Final extract, air-jet and supply-air quantities shall be established from the selected canopy manufacturer's recommendations and the design duty of the associated cooking equipment.

The canopy manufacturer shall confirm that the proposed airflow rates provide adequate capture and containment for the cooking equipment installed beneath the canopy. Manufacturer's published maximum airflow values shall not automatically be regarded as the required design airflow.

The specialist canopy supplier shall coordinate the canopy selection with the kitchen equipment layout and advise the Mechanical Contractor/Engineer of any required changes to the design airflow before manufacture.

12.2.9 Duct Connections

The Contractor shall provide factory-formed extract, air-jet and supply-air duct connection collars/spigots as required. Connection sizes, quantities and locations shall correspond with the manufacturer's standard configuration for the selected canopy dimensions.

The Contractor shall coordinate all connection positions with the mechanical services drawings before manufacture. Seal duct connections to prevent air leakage and, on the extract side, leakage of grease or condensate. Kitchen extract ductwork connected to the canopy shall comply with the separate kitchen extract ductwork specification.

12.2.10 Access and Cleaning

The Contractor shall design the complete canopy to facilitate regular inspection, cleaning and maintenance. Grease filters, grease collection components and other components requiring routine maintenance shall be readily removable without specialist tools.

Internal surfaces accessible during routine maintenance shall be smooth and readily cleanable. Provide access to supply and extract plenums where necessary for inspection and cleaning. The installation shall permit removal and replacement of filters without interference from cooking equipment, ceilings, lighting or adjacent services.

12.2.11 Lighting

Where canopy lighting is indicated in the schedules or drawings, the Contractor shall provide factory-integrated luminaires suitable for the temperature, grease and moisture conditions associated with commercial kitchens.

Luminaires shall have smooth, readily cleanable exposed surfaces and shall be adequately sealed against ingress of grease and moisture. Lighting shall provide uniform illumination of the cooking equipment below without unacceptable glare. Provide local switching and/or interface with the kitchen control system as indicated on the electrical and controls documentation.

12.2.12 Fire Safety and Suppression Coordination

The Contractor shall coordinate the canopy and associated extract system with the kitchen fire-suppression strategy. Where a proprietary kitchen fire-suppression system is required, coordinate all detection, discharge nozzles, pipework, brackets and interfaces with the canopy manufacturer before manufacture and installation.

Nozzles, detectors and associated equipment shall not obstruct grease-filter removal, canopy cleaning, lighting, air-jet outlets or supply-air panels. Any penetrations through the canopy shall be factory formed where practicable. Site drilling or modification of the canopy shall not be undertaken without agreement of the canopy manufacturer and fire-suppression specialist.

12.2.13 Controls and Interlocks

The Contractor shall interlock canopy extract, air-jet and supply-air systems with the associated kitchen ventilation controls. The control arrangement shall establish the required extract duty before or simultaneously with operation of the associated supply systems.

The Contractor shall provide interfaces with gas interlock systems, kitchen equipment enable signals, fire alarm/fire suppression and BMS systems where indicated elsewhere in the specification. Failure of the kitchen extract system shall initiate the required alarm and equipment shutdown/interlock functions specified for the kitchen.

12.2.14 Installation

The Contractor shall install canopies strictly in accordance with the manufacturer's instructions and approved shop drawings. Mount at the manufacturer's recommended height above the cooking equipment while maintaining the required capture and containment performance. Coordinate canopy dimensions, position and mounting height with the final catering equipment layout before manufacture.

Wall-mounted canopies shall be installed tightly against the finished wall or provided with suitable stainless-steel infill/flashings to prevent inaccessible grease traps. Island canopies shall be accurately centred over the associated cooking island and securely suspended from the building structure.

The Contractor shall provide all brackets, threaded suspension rods, channels, frames and other supports necessary for a complete installation. Do not support the canopy from ductwork, suspended ceilings or other building services.

12.2.15 Submittals

Prior to manufacture, submit coordinated manufacturer's drawings and technical data showing canopy type and model; overall dimensions; mounting height; stainless-steel grade and finish; extract, air-jet and supply-air quantities; duct connection sizes, quantities and positions; grease-filter type and quantity; pressure losses; canopy weight and support requirements; lighting, where applicable; access and maintenance requirements; and electrical requirements for integral equipment.

The Contractor shall submit confirmation from the canopy manufacturer that the proposed canopy selection and airflow rates are suitable for the final cooking equipment arrangement.

12.2.16 Commissioning

The Contractor shall commission the complete canopy installation in conjunction with the kitchen extract and supply-air ventilation systems. Measure and record the extract, air-jet and supply-air quantities serving each canopy. Balance the systems to the manufacturer's design requirements.

Use the manufacturer's pressure measurement ports and commissioning data, where provided, to establish and verify the required extract airflow. Demonstrate satisfactory capture and containment across the complete canopy under representative operating conditions.

The Contractor shall check that introduction of supply and air-jet air does not adversely affect plume capture, gas flames, pilot lights or operation of the cooking equipment. Demonstrate correct operation of all dampers, integral fans, lighting, controls, interlocks and alarms. Include final measured airflows, pressure readings, damper positions and test results within the commissioning records and O&M documentation.

12.3 Kitchen Fire Suppression System

12.3.1 General

The Contractor shall provide a proprietary automatic wet-chemical fire-suppression system to protect the commercial cooking appliances, extract canopy, grease filters, extract plenum and associated extract system as required by the approved specialist system design.

Basis of design shall be ANSUL R-102, consistent with the existing catering installation, or approved equivalent, subject to confirmation of compatibility with the proposed cooking equipment, canopy arrangement and project fire strategy.

12.3.2 Specialist Design and Coordination

The complete system shall be designed, supplied, installed, tested and commissioned by an authorised specialist fire-suppression contractor in accordance with the suppression system manufacturer's requirements and all applicable statutory, fire-safety and insurance requirements.

The specialist contractor shall undertake a site survey and coordinate the installation with the canopy manufacturer, catering equipment supplier, Mechanical Contractor, Electrical Contractor and fire alarm specialist prior to manufacture and installation.

The specialist shall determine the required hazard coverage, detection arrangement, nozzle types and locations, agent quantity and associated interfaces from the final cooking equipment and canopy layout.

12.3.3 Detection and Discharge

The Contractor shall provide automatic detection and wet-chemical discharge arrangements protecting all applicable cooking hazards. Provide protection to the canopy, grease filtration/plenum and extract duct as required by the proprietary system design.

The Contractor shall provide correctly selected and positioned discharge nozzles complete with manufacturer-approved nozzle caps and all associated detection equipment, pipework, brackets and fittings. Coordinate nozzle and detection positions with removable grease filters, canopy lighting, air-jet outlets, supply-air panels and all other canopy components. The completed installation shall permit normal removal and cleaning of filters without disturbing the fire-suppression installation.

12.3.4 Manual Activation

The Contractor shall provide manual activation device(s) in readily accessible locations remote from the protected hazard and positioned along the means of egress, with final locations determined by the fire-suppression specialist and applicable fire-safety requirements.

12.3.5 Energy Isolation and Interfaces

Upon operation of the fire-suppression system, automatically isolate gas supplies and electrical power to protected cooking appliances as required by the proprietary system design.

The Contractor shall provide all necessary interfaces with the kitchen ventilation controls, gas interlock system, electrical cooking equipment, fire alarm system and BMS where applicable. Provide volt-free contacts, relays, shunt-trip interfaces and other control components necessary to achieve the required cause-and-effect operation.

12.3.6 Ventilation Cause and Effect

The required operation of the extract fan, make-up air fan and canopy air-jet/supply-air systems following suppression-system activation shall be determined by the approved fire-suppression system design and project fire strategy. Fan shutdown or continued operation shall not be assumed without confirmation by the specialist designer.

The Contractor shall submit the proposed cause-and-effect sequence for review prior to commissioning.

12.3.7 Canopy Coordination

Any penetrations or modifications required to the canopy shall be coordinated with the canopy manufacturer before manufacture. Site modification of the canopy shall not be undertaken without approval of the canopy manufacturer and fire-suppression specialist.

12.3.8 Testing, Commissioning and Documentation

Following completion, the Contractor shall fully test and commission the system, including automatic detection, manual activation, cooking appliance energy shutdown, gas isolation, ventilation interfaces and fire alarm interfaces.

The Contractor shall provide certification, approved system layout drawings, nozzle locations, equipment schedules, cause-and-effect information, commissioning records, operating instructions and maintenance requirements as part of the O&M documentation.

13 **HVAC Controls and Building Energy Management System**

13.1 **Introduction**

Under this section the Contractor shall include for the supply and installation of a Building Management System (BMS) to control the Heating, Ventilation, Air Conditioning and Domestic Hot Water systems and to monitor other services within the building.

After the controls have been installed and connected, commissioning tests shall be carried out to ensure that all items are functioning in the manner for which they are intended and that all items are connected correctly. Commissioning shall be in accordance with CIBSE Commissioning Code C.

All field mounted control equipment such as control valves, temperature sensors, pressure switches, flow switches, shall operate at voltages of no greater than 24 volts AC,. Under no circumstances will control items operating at voltages higher than this be acceptable.

13.2 **Building Management System (B.M.S.) General Requirements**

The Building Management System (BMS) shall be an open source computer-based control and monitoring system for mechanical and electrical services with a standard P.C. and printer used as the customer interface to the system.

The system shall be supplied with a complete PC package including monitor and keyboard. The PC shall have, processor (highest speed available), CD Rom drive, 4 No. USE drives, 1 TB hard disk, 4GB RAM, monitor, keyboard, mouse etc.

The P.C. shall be connected by a ring cable loop to all the field outstations to which all local plant shall be connected. The P.C. shall have graphical screens of the building layout and of all plant under control.

It shall be configured such that a user can simply pick the area and the plant required and all relevant information shall be displayed on the screen showing the status of all equipment, temperature values and set points etc.

It shall be possible to make changes of time or temperature on the graphic and allow this information to be sent to the appropriate outstation, which will incorporate the changes in its programme.

The system shall be capable of providing features as described in the following paragraphs.

- Time of Day Control:
- Optimum Start / Stop Control
- PID Control
- Alarm Handling
- Data Logs
- Maximum Demand Management
- Metering / Reports
- Duty Rotation
- Hours run
- Holiday Programme.

The BMS shall be fitted with a modem, which shall connect via a direct telephone line (to be installed under this contract).

The BMS outstations shall be incorporated in the various HVAC Motor Control Centres throughout the building. The control strategies shall include for

- Boiler sequencing
- Optimised Start/Stop of all plant
- Individual control of all pumps (Duty/Standby with automatic weekly rotation)
- Status monitoring of pump and fans by means of current switches
- Fault condition monitoring on heating system pressurisation unit
- Weather compensation with room influence on all mixing circuits
- Two stage frost protection
- Automatic running of pumps during long periods of inactivity to prevent seizing
- Data logging of all field items (15 minute intervals)
- Hours run indication for all plant items.

The control specialist shall be responsible for designing the strategies required to ensure that the plant runs in the most energy efficient manner possible. The control strategies should be forwarded to the engineers prior to commissioning, for approval.

The Controls Specialist shall allow for creating and programming into the BEMS system schematic colour graphic diagrams of the plant, generally in accordance with the plant installed. The graphics shall indicate all items of plant, status, alarm conditions, measure values of temperature and all other relevant information. Separate graphic diagrams shall be provided for the ventilation system and the heating system. 2 No dynamic colour graphics shall be produced.

13.3 Gas Interlock

In the event of a gas leak being detected by the gas detection system, the LPHW system will be disabled by hardwired interlock. An alarm is generated at the BMS supervisor on this condition and a lamp is illuminated on the panel fascia. When the gas alarm condition resets the LPHW system controls will resume normal operation.

13.4 Wiring and Installation of Temperature Detectors and Panels

All wiring associated with HVAC control shall be carried out by the Electrical Contractor in accordance with schematic drawing to be prepared by the controls specialist and approved by the engineers.

Wall and duct mounted temperature detectors and controls devices shall be supplied by the Controls Specialist and handed to the Electrical Contractor for fixing in the positions recommended by the Automatic Controls Specialist. The Controls Specialist shall allow for visits to site to mark-up the position of all controls devices for the Contractor to wire to.

The Mechanical Contractor shall be responsible for the off-loading and protection of the Motor Control Centre with the Controls Specialist supervising this work. The Controls Specialist shall make due allowance of this supervisory work in their tender.

13.5 Outstations

All outstation equipment shall be manufactured by the Controls Specialist utilising their latest advanced range of Direct Digital Controllers. The outstations shall consist of all necessary hardware and software to provide a totally Stand Alone and intelligent unit capable of all monitoring, corrective action, and control functions as required.

Each intelligent outstation shall control its local plant independently of the control of any central BEMS workstation. The Outstations shall continue to operate fully in the event of a possible total failure of the BEMS workstation or any other outstations. The outstations shall be microprocessor based, multi-tasking, direct digital control units.

A local operator's keypad display panel shall be housed on the fascia of each control panel for local command entry, instantaneous data display, program additions and modifications. With the use of a fascia keypad the operators display panel shall allow the user to address parameters and status of plant, change time clock settings and modify all set points using simple English text.

All possibility of unauthorised adjustment shall be eliminated either by physical means or by the use of a password system.

The outstation shall incorporate a power supply unit to preserve existing software and data for a period of 30 days upon loss of power to the outstation. The batteries having a minimum life span of three years. Upon restoration of normal power the outstation shall automatically resume full operation without any manual intervention whatsoever. All default values shall automatically reset following restoration of power supplies and the central BEMS workstation shall be updated automatically with the working values.

Each "Stand Alone" Outstation shall consist of modular hardware with plug-in enclosed processors, power supplies and input/output modules. A sufficient number of controllers shall be provided to fully meet the requirements of this specification. All Outstations shall have a self-analysis checking feature and shall transmit all malfunction messages to the central BEMS workstation.

The outstation shall be suitable for programming locally at the plant room and centrally from the BEMS workstation.

All outstation equipment shall operate satisfactorily in the electrical environment and ambient temperatures experienced within plant rooms or boiler house areas. All equipment shall be protected against the effects of conduction, heat transfer and radiated mechanical/electrical interference.

Outstations shall provide serial data communication ports for simultaneous operation of multiple operator devices such as industry standard printers, Laptop workstations, PC workstations and panel mounted or portable operator terminals.

Outstations shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers, or network terminals.

Outstations shall provide visual (LED) local status indication for each binary input and output for verification of all point conditions without the need for an operator device.

As a minimum requirement each outstation shall support the following types of inputs and outputs.

- Digital inputs for status/alarm monitoring.
- Digital outputs for On/Off equipment control.
- Analogue inputs for temperature, pressure, humidity, flow, measurement etc.
- Analogue outputs for control of valves, dampers etc.
- Pulsed outputs for damper/control valve positioning.
- Pulsed inputs for energy monitoring of utility meters, gas, electricity and water etc.
- Universal input/output points up to 20 configurable channels.

The system shall be modular in nature and shall permit easy expansion through the software application, workstation hardware, field controllers, sensors and actuators.

Each outstation shall be provided with 25% spare hardware points and printed circuit boards for each type of input/output points for future installations.

Suitable voltage filters, surge protectors and stabilizers shall be provided at all outstations as well as field point terminations to suppress induced voltage transients surges and fluctuations, consistent with the LEE and current British Standards. The devices shall ensure the outstation continues to function successfully at all times.

13.6 Electricity Meter Monitoring

Electricity kWhr meters shall be provided on the individual electrical circuits serving the heat pumps to allow monitoring of energy use. The electricity meters shall be supplied and installed by the panel manufacturer.

The Controls Specialist shall be responsible for the correct sizing and selection of all meters and equipment in accordance with the currents, voltages, flow rates, line pressures, and sizes as indicated in the Specification.

13.7 Mains and Cold Water Meters

Rotary piston volumetric water meters shall be installed on mains and cold water circuits as indicated on the drawings.

The water meter shall be inline pipe mounted. They shall allow for come complete with a numerical roll contained in a waterproof mechanism. The meters shall come equipped with a pulsed output device to allow meter reading through the BMS. Water meters to comply with BS EN 14154-1:2005 and shall be suitable for billing purposes.

13.8 Gas Meters

Gas meters shall be installed on the gas supply lines serving the boilers and domestic hot water heater. They shall offer the following features:

- Long term accuracy and reliability
- Robust, maintenance free
- Low pressure loss & wide measuring ranges
- Pre-equipped for future communications needs - Compatible with all Cyble MIUs (Cyble Sensor, Cyble M-Bus, Cyble RF).

Meters shall comply with EN1359 & O.I.M.L compliant and MID (PTB) / DVGW approved.

13.9 Legionella Alert Sensors

Immersion type pipe stats shall be installed on all water services pipework in ceiling voids, the cold water storage tank, the mains water break tank and the rain water harvesting break tank, to monitor the temperature of the water contained in the pipework.

An alert shall be raised through the BMS and notify staff in the GP and HSE reception through a combined sounder and strobe unit with an integrated silent button. An audible and visual alarm shall also be raised at the MCC panel.

13.10 Weather Compensation Control

Weather compensation shall be provided for each radiator circuit as indicated. It shall comprise of a Mixing valve, a Valve actuator, a Flow temperature sensor and an Outside temperature sensor.

The flow temperature to the radiators shall be varied in accordance with the outside temperature. The flow temperature shall vary between 20°C and 80°C corresponding to an outside temperature range of 20°C down to - 4°C. The radiator pump shall switch off if the outside temperature is 20°C or higher.

13.11 Boiler Frost Protection

A two stage frost protection system shall be provided by means of immersion thermostats fitted into the return of the boiler and an outside frost on a north facing wall. The outside frost Stat shall enable all circulating pumps if the external temperature drops below 2°C. The immersion frost stat shall enable all boilers and pumps if the return water temperature drops below 5°C.

13.12 **Auto Fill Unit - High and Low Limit Pressure Switches**

The packaged pressurisation unit shall operate a pressurisation pump when the pressure in the hot water flow primary circuit decreases below 700 kPa. The pressure sensor shall be positioned in the primary flow circuit downstream of the primary pump before any branches. The pressurisation pump shall continue to operate until the pressure setpoint is obtained.

Activation of a high pressure switch shall disable the boiler and close the gas valve. The primary and secondary pump shall continue to operate as determined by the run on period. Activation of a low pressure switch shall disable both the boiler and the primary and secondary pumps. A low pressure alarm shall be raised on the BMS central supervisor.

13.13 **Boilerhouse - Temperature Monitoring and Control**

Immersion temperature sensors shall be provided in the boiler flow and return headers to provide the following temperature monitoring and control

- Maintain circulating pumps running until boiler header flow temp falls below 55°C.
- Provide alarm if preset setting is not achieved within a specified time.

An external Temperature Sensor shall be provided to monitor external conditions. It shall be mounted on a north facing wall for general monitoring for weather compensation, optimum start etc.

13.14 **Boiler Sequencing**

A boiler sequencing system shall be provided to provide lead-lag and duty rotation control of the boilers. The system shall be designed to run the boiler plant at its maximum efficiency, i.e. minimum fuel input to match the load condition.

The control strategy for the boiler sequencing system shall take due account of the boiler type and whether it would be more efficient to run one boiler at full load or two boilers on low flame or minimum load. The controls specialist shall be responsible for liaising with the boiler supplier in this regard and for determining the optimum solution.

13.15 **Differential Pressure Switches for Pumps**

All water flow pressure switches for installation across pump sets shall be supplied by the Controls Specialist complete with all the necessary mounting brackets, tappings, connection fittings and similar devices. The pressure switches will be installed under the Mechanical Section of the Works with suitable isolating ball valves in the positions recommended by the Controls Specialist. The pressure switches shall be equipped with diaphragm switches suitable for use with water, oil, air and other media and shall be fitted with changeover contacts.

13.16 **Control Valves**

The specialist supplier shall supply and install all instruments and control valves required to control and monitor the complete installation as indicated on the drawings and information provided by the mechanical Contractor.

Control valves shall be sized by the Controls Specialist to ensure the correct flow characteristics for the control application. No control valves shall be used which have integral strainers, or which have

special requirements for the provision of strainers. Control valves shall be of the 3-port equal percentage plug and seat design (complete with electrically operated actuators) installed in the pipe work as detailed on the drawings. Rotary shoe valves shall not be acceptable. All control valves shall be fully modulating, responding to a 0-10VDC control signal and shall have a manual operating facility on the valve actuator, allowing an operator to manually position the valve.

Control valves up to and including 50mm shall have screwed connections and those above shall have flanged connections, unless otherwise stated. Valve flow rate duties shown on the drawings are for tendering purposes only and shall be confirmed with the Engineer before ordering.

Control valve actuators shall be correctly sized to provide smooth operation under design and operating conditions. All control valves shall have stainless steel stems complete with brass trims.

All control valves associated with frost coils on air handling plant shall have a spring return mechanism activated by a break in the electrical supply to the actuator, and shall be arranged to fail open to the coil for LTHW applications and closed to the coil for steam applications.

Valves shall have a maximum rated pressure of at least 200% of the normal working pressure of the system in which they are to be installed. Let by/leakage rate shall not exceed 0.5% of full valve duty. Valves shall be sized to give an authority in the region of 0.5 and shall never be less than 0.3.

Valves used on heater battery/heat exchangers shall have an equal percentage or modified parabolic characteristic and their range ability shall not be less than 30:1. They shall have a stroke of not less than 20 mm with the exception of terminal unit valves. They shall have their actuators directly coupled to the valve spindle and shall drive the valve in both directions.

Valves shall be fitted with valve position indicators clearly marked to show the fully open and fully closed positions. Modulating control valves shall be driven on a 0-10V DC signal or a 4-20mA signal.

13.17 **Pipe Mounted Temperature Sensors**

All immersion pockets in piping shall be of the separable type and be either brass or stainless steel to suit the application. The immersion pockets shall to be supplied by the Controls Specialist complete with all the necessary connection fittings for installation into a 15mm screwed boss. Immersion type temperature sensors shall be mounted in the brass pocket, inserted into the pipe work, of sufficient length to ensure complete immersion of the sensing element so that water can freely circulate around the pocket.

All pipe mounted temperature sensors shall be of the high accuracy PT100 type. The housing for the electronics and terminals shall be weatherproof to IP67 suitable for pipe work applications. The device shall have a 6.0mm diameter stainless steel probe with universal fitting kit.

The housing shall be suitable for 20mm conduit entry and complete with fixed connectors for ease of installation.

The range of all pipe mounted temperature sensors shall be -10 °C to +160 °C with an accuracy of plus or minus 1 % across its entire operating range.

All immersion sensors shall be fixed in the pipe work under the mechanical section of the works in the positions recommended by the Controls Specialist.

13.18 **Wall Mounted Temperature Sensors and Set Point Adjusters**

All wall mounted temperature sensors shall be of the high accuracy PT 100 type with 4-20 milliamp 2-wire output.

The sensing element shall be housed within a low profile enclosure designed for good thermal response. All enclosures shall be arranged for standard 20mm conduit box.

Where local set point adjustment is required the adjustment dial shall be a rotary potentiometer which connects to the 10K ohm resistive input of the intelligent DDC controller. The local set point adjustment device shall be engraved with positive (+) and negative (-) indication at each end of the full scale deflection. The range of all wall mounted temperature sensors shall be -10°C to 40°C. with an accuracy of plus or minus 1°C across its entire operating range.

13.19 **Weatherproofing of Externally Mounted Controls Equipment**

All controls equipment which is located on air handling plant externally on the roof shall be suitably weather protected to IP55. This shall be achieved by housing the controls equipment in proprietary enclosures constructed from clear GRP with suitable gaskets and cable glands to avoid the ingress of rainwater and moisture. The enclosures shall also prevent corrosion to all devices due to extreme weather conditions such as frost, snow and intense sunshine. Control valves shall be completely contained within the weatherproof enclosures with suitable gasketing and grommets provided for the entry of the pipe work.

13.20 **HWS System**

The direct gas fired water heater system shall be controlled on a time schedule through the BMS. The system shall include HWS Return Pump, LPHW control valve, immersion temperature sensor and high limit thermostat.

The Primary and Secondary pumps shall be enabled by the BMS on a HWS time-scheduled basis.

The secondary return pump shall be controlled within the time schedule by a pipe thermostat to maintain the temperature in the hot water loop above 57°C.

An immersion thermostat is installed in the calorifier set at 70°C. In the event of the temperature in the calorifier exceeding this temperature the LPHW control valve shall be closed. An alarm is generated at the BMS supervisor on this condition. This condition must be reset by pressing an illuminated push button on the panel.

The BMS shall monitor the temperature in the calorifier and control the temperature as follows:

- If the temperature in the calorifier falls below the control set point, the control valve shall be modulated to the open position to maintain set point. If the temperature in a calorifier rises above the set point, the control valve shall be modulated to the closed position to maintain set point.

Automatic system pasteurisation shall allow a temporary increase in stored hot water temperature on a regular basis. Stored water shall be increased to 73°C.

13.21 **Commissioning / Handover**

The controls specialist through the Contractor shall prepare a written schedule giving a minimum 10 day notice period of proposed test dates for witnessing by the client representative. Once the entire system has been commissioned, the contractor shall offer the system for witness testing by the client representative giving at least 1 weeks advance notice. The contractor shall expect that the entire system including any sub-systems will be witnessed on a point by point basis.

The Contractor shall provide the original Test and Compliance Certificates for inclusion in the O&M Manual. These certificates must be presented no later than Practical Completion Stage, as failure to do so will delay practical completion and all costs for delays attributable will be borne by the contractor.

On completion of system installation full testing and commissioning is to be carried out in line with CIBSE and BSRIA guidelines and current ETCI Regulations.

Upon project completion the controls specialist will provide complete Operation and Maintenance instructions with as installed drawings.

The Contractor and Controls Specialist shall be available for attendance at a formal handover and presentation of the O&M Manuals to the client and a date and time to be advised by the consulting engineer. The controls specialist will be expected to demonstrate a working understanding of the installed systems to a level that can be conveyed to the client to enable him to operate the systems and installations to their full potential with confidence.

Post Handover and for an initial “run-in” period following occupation of no less than 2 weeks the Contractor and controls specialist shall maintain an onsite presence of appropriate persons to ensure the seamless transition for the new occupants.

Following handover the Contractor shall attend monthly review meetings on site to deal with any arising issues and ensure identified “snag” items are being actioned.

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

As conditions for normal operation of the system would vary across both winter and summer periods it is a strict requirement that the controls specialist provides two stages of commissioning and demonstrations of the system.

14 **SANITARY FITTINGS**

14.1 **Introduction**

The Contractor shall include for the supply, installation and connecting up of all the sanitaryware as detailed in the Equipment Schedules. He shall liaise with the Builder in relation to the installation of adequate fixing grounds.

The Contractor shall not order any sanitaryware until written confirmation of approval is provided by the Client or the Client's representative.

14.2 **Connection of Sanitaryware**

All sanitary fittings shall be fitted with mini-ball single turn isolating valves of Enkotak chromium plated finish.

The Contractor shall carry out all necessary pressure testing the system to 5 bar and held drop tight for 8 hours as described elsewhere in this specification.

15 **SUPPORT FOR PLANT AND EQUIPMENT**

15.1 **Introduction**

Under this section the Contractor shall include for the supply and installation of supports for all piped services, ductwork, plant and equipment throughout the entire installation.

15.2 **Support for Plant and Equipment on roofs**

All plant, ductwork, pipework and associated cable trays shall be supported and sufficiently clear of the roof to allow for future maintenance. The supports shall comprise a Big Foot plant support system as supplied by DWG Eire Ltd equal and approved. Installation shall concur with manufacturers detailed drawings.

The plant support system shall comprise a rubber base, and a hot dipped galvanised, height adjustable up stand.

The contractor shall submit plant loadings to the supplier to confirm base sizes and quantities.

16 **TESTING AND COMMISSIONING OF MECHANICAL SERVICES**

16.1 **Introduction**

Under this section the contractor shall include for testing and commissioning all mechanical services forming part of the contract works including low pressure hot water systems, chilled water systems, ventilation systems, air conditioning systems, compressed air systems, domestic water systems etc

All testing and commissioning shall be in accordance with the following applicable codes and standards:

- Safety Health and Welfare Regulations
- CIBSE Commissioning Codes A, B, C, W, and R
- BSRIA Application Guide 3/89.1 – The commissioning of Air Systems in Buildings
- BSRIA Application Guide 2/89.1 – The commissioning of Water Systems in Buildings
- BSRIA Application Guide 8/91 – Pre-commission cleaning of water systems.
- Manufacturers Recommendations and Instructions
- HVAC Codes

National Standards Authority – Domestic Gas Installations I.S.813: 1996

Prior to the testing and commissioning of the systems, all dirt, dust, debris etc. shall be removed from all plant and equipment, which shall be in turn cleaned inside and out. The installation shall be completed to the satisfaction of the Engineers.

Cleaning of systems shall follow recommendations of the relevant CIBSE Commissioning Codes and where indicated chemical cleaning of water systems shall be carried out where specified.

Any items of equipment set to operate at or below the test pressure shall be isolated or removed prior to applying the test.

Where pipework is buried or concealed permanently within the structure, such as trenches sealed ducts or roof spaces, etc. These sections shall be tested in addition to the above test prior to concealment.

The contractor shall ensure that the pipework is installed to the latest standards i.e. adequately supported, that handles or hand wheels, as appropriate, are fitted to all valves, etc.

The Contractor shall demonstrate that the system is fully balanced and that correct flow rates are available at all outlet positions to the Engineer or their representative.

All pressure tests shall be carried out prior to the application of insulation.

All pressure test certificates must be witnessed and signed by the Engineer.

16.2 **Pre-Commission Cleaning**

Systems shall be flushed with water two to three times initially or until the water is completely clear. All strainers should be taken out and cleaned after flushing with water. Pre-commission cleaner ChemSpense 105, which is dosed @1% of system volume, shall then be added direct to system. The system water control should then be circulated for at least 4 and up to 24 hours by-passing fan coil units, AHU's or heat exchangers. The complete system shall then be drained to remove all iron debris and pre-commission cleaning chemicals. This should be confirmed by reference to system water conductivity.

After draining the systems they should be thoroughly flushed with fresh water at least twice again until clear. Aqua Chem personnel shall test the system and advise if further flushing is required. The contractor shall spot check a number of strainers and if clean it is not necessary to check all of them. If there is still some debris in them all strainers need to be checked and cleaned.

During the final flushing the contractor shall open up all fan coil units and AHU's to allow the water to pass through them.

Once the systems have been thoroughly flushed they should be immediately dosed with the following inhibitor: ChemHib 201 @ 1% of the volume of the heating and chilled systems.

Glycol, if required, shall also be added to the chilled system while it is being filled with water and the ChemHib 201 inhibitor shall also be added at this time as well.

The systems shall then be tested to ensure that they have the required level of inhibitors for correct corrosion protection.

Glycol levels should also be checked using a Refractometer and the level recorded on a commissioning report.

Full Certification should be provided after each system has been pre-commission cleaned and dosed with correct amount of inhibitor.

16.3 Ductwork Systems

The Contractor shall submit to the Engineer a documented commissioning report for all ventilation systems containing the following items:

- Volume flow rate of each supply and extract fan.
- Resistance of each supply and extract fan.
- Running current and overload setting of each fan.
- Volume flow rate for each grille and diffuser.

The individual points at the fans shall be plotted on the individual performance charts.

For belt-driven fans, the Contractor shall allow for one pulley change per unit and shall not resort to the use of dampers for this purpose. The Contractor shall include for the manufacturer to be in attendance during testing and commissioning of the unit(s) on site.

A set of spare filters to completely replace each filter assembly shall be provided for hand-over to the Employer immediately before practical completion.

16.4 Mains Water

All mains water pipework shall be swabbed and disinfected before being put into supply. The pipelines should be disinfected with water having a minimum concentration of 20 mg/L of free available chlorine left in the main for a period of at least 24 hours. Chlorine residual tests shall be taken at the end of the main furthest from the point of injection. The sterilisation process shall be repeated if the chlorine residual is less than 10 mg/L. The chlorinated water must be discharged into a foul sewer.

On completion of cleaning of the installation Contractor shall fill the mains water system with clean water and subject it to a hydraulic test of 1.5 times it's working pressure and held drop tight for 8 hours.

16.5 Hot and Cold Water Services & Cold Water Storage Tanks

After installation the cold water storage tank, hot and cold water services pipework shall be flushed through, cleaned & Sterilised in accordance with the Irish Safety, Health and Welfare at work (Biological Agents) Regulations, 1994/1998, BS 6700; 1997 and L8200 prior to pressure testing.

On completion of cleaning of the installation Contractor shall fill the hot and cold water system with clean water and subject it to a hydraulic test of 1.5 times it's working pressure and held drop tight for 8 hours.

Immediately prior to the date of completion the Contractor shall take samples for a number draw off outlets and have them tested for bacterial contamination by an independent laboratory. The Sub-Contractor shall forward to the Engineer all results and test certificates upon receipt.

The Contractor shall record the temperature at every domestic hot water tap and adjust as necessary to ensure the temperature does not exceed 43 degrees C.

16.6 **Soils and Waste System**

The contractor shall include for testing and commissioning the entire soils and wastes installation in accordance with B.S. 5572, 1978. Pipework and fittings should be capable of withstanding an air test of positive pressure of at least 38mm water gauge for at least 3 minutes during which each trap should maintain a water seal of at least 25mm.

This Contractor shall provide temporary traps on each stack for the purpose of each test. The Contractor shall supply and hand over witnessed pressure test certificates for all pipework tests.

16.7 **Low Pressure Hot Water Systems**

On completion of cleaning of the installation Contractor shall re-charge the LPHW heating system with clean water and subject it to a hydraulic test of 1.5 times it's working pressure and held drop tight for 8 hours.

The Contractor shall submit to the Engineer a documented commissioning report for all low pressure hot water systems containing the following items:

- Volume flow rate of each pumped circuit.
- Resistance of each pumped circuit.
- Running current and overload setting of each pump.
- Water flow rate for each circuit and heater battery.

17 **LABELLING OF MECHANICAL SERVICES**

17.1 **Introduction**

The Contractor shall include for providing identification and labelling to all mechanical services forming part of the contract works including low pressure hot water systems, chilled water systems, ventilation systems, air conditioning systems, compressed air systems, domestic water systems etc

The Contractor shall be responsible for assigning identification references to valves, plant and equipment, individual circuit control devices, etc. in accordance with the numbering/referencing system used in the record documentation.

Sample identification labels shall be submitted to the Engineer for approval.

Care shall be taken to ensure that the label material is suitable for the temperature of the surface to which it is to be attached.

17.2 **Plant Identification**

The Contractor shall supply and install identification labels for all items of plant and equipment. The label shall indicate the item of plant and its reference number which shall be consistent with all record documentation.

Identification labels shall be engraved traffolite with black printing in capital letters, 8 mm high on a white background. Labels shall be securely fixed, in a visible position, to the item of plant. Labels shall be mechanically fixed; adhesive fixing will not be accepted.

17.3 **Drinking Water Identification**

The Contractor shall mount an Ivorine label clearly marked "Drinking Water" all drinking points.

17.4 **Ductwork Identification**

Unless otherwise indicated, all distribution services shall be colour coded and provided with symbols for identification purposes. Identification coding for ductwork, including thermal insulation, shall be in accordance with HVCA publication DW/144. For pipework, including thermal insulation, the basic colour and colour coding shall be in accordance with BS 1710.

Proprietary PVC identification bands or triangles shall be securely fitted to pipework throughout the building. These shall identify the service and shall be fitted in the following locations unless otherwise indicated:-

- Both sides of each valve.
- At each change in direction.
- At each branch connection.
- At each floor level in vertical service ducts.
- On all horizontal runs at a minimum of 4m intervals.
- Both sides of any wall or partition through which the pipe passes.

In addition to colour bands or triangles and unless otherwise indicated, all ductwork and pipework in plant rooms, service areas, ceilings and floor voids, whether insulated or not, shall be identified with black or white letters to show the type of service and direction of flow. Services shall be shown as follows:-

- Fresh air FA

- Supply air SA
- Return air RA
- Exhaust air EA

The letters F and R shall be added to piped distribution to show flow and return respectively.

Arrows indicating direction of flow shall also be applied after joints, intersections, etc. and on straight runs at intervals not exceeding 16m.

17.5 Pipework Identification

Unless otherwise indicated, all distribution services shall be colour coded and provided with symbols for identification purposes. Identification coding for ductwork, including thermal insulation, shall be in accordance with HVCA publication DW/144. For pipework, including thermal insulation, the basic colour and colour coding shall be in accordance with BS 1710.

Proprietary PVC identification bands or triangles shall be securely fitted to pipework throughout the building. These shall identify the service and shall be fitted in the following locations unless otherwise indicated:-

- Both sides of each valve.
- At each change in direction.
- At each floor level in vertical service ducts.
- On all horizontal runs at a minimum of 3m intervals.
- Both sides of any wall or partition through which the pipe passes.

In addition to colour bands or triangles and unless otherwise indicated, all ductwork and pipework in plant rooms, service areas, ceilings and floor voids, whether insulated or not, shall be identified with black or white letters to show the type of service and direction of flow. Services shall be shown as follows:-

- | | |
|----------------------|------|
| •Condensate | COND |
| •LTHW Heating | LTHW |
| •Mains water service | MWS |
| •Cold water service | CWS |
| •Hot water service | HWS |
| •Hot water return | HWR |

Arrows indicating direction of flow shall also be applied after joints, intersections, etc. and on straight runs at intervals not exceeding 16m.

17.6 Plant Identification

The Contractor shall supply and install identification labels for all items of plant and equipment. The label shall indicate the item of plant and its reference number which shall be consistent with all record documentation.

Identification labels shall be engraved traffolite with black printing in capital letters, 8 mm high on a white background. Labels shall be securely fixed, in a visible position, to the item of plant. Labels shall be mechanically fixed; adhesive fixing will not be accepted.

17.7 Drinking Water Identification

The Contractor shall mount an Ivorine label clearly marked "Drinking Water" all drinking points.

17.8 Valve Identification

The Contractor shall supply and install valve identification discs for all valves, which shall be attached to valves by means of brass chains.

The valves shall be readily identifiable by numbers, which shall be consistent with all record documentation.

Identification discs shall be engraved traffolite 35mm dia. discs and shall indicate the particular service by colour code and the number of the valve relating to the layout of the particular installation.

The Contractor shall be responsible for assigning identification references to valves, plant and equipment, individual circuit control devices, etc. in accordance with the numbering/referencing system used in the record documentation.

18 **OPERATION AND MAINTENANCE MANUALS**

18.1 **Introduction**

Under this section the Contractor shall include for the following operations and maintenance manuals including "as-installed" drawings for issuing to the Client upon completion of the works:

- 2 no. hard copies & 1 no. electronic copy

The term maintenance manual shall be deemed to include all necessary maintenance and operating instructions and record drawings for the entire installation.

A draft copy of each of the 3 no. maintenance manuals shall be issued to the Engineers for approval at least two months in advance of the intended date of practical completion. Drawings shall be prepared in AutoCAD format, latest edition, and shall be submitted in both hard and electronic format to the Engineers for approval. This Contractor shall carry out any amendments requested by the Engineers.

The Contractor shall hand over the manuals to the client and shall instruct the client's staff in the operation and maintenance of the various components forming the installation.

The maintenance manual shall comprise one of more A4 lever arch ring binder files, endorsed with the project details and contractors name and address. Transparent cellophane envelopes shall be provided to hold copies of the "as-installed" drawings and any other items which cannot be punched. Cardboard dividers shall be provided to separate the various sections of the manual. Each divider shall be neatly labelled.

18.2 **Mechanical Operations and Maintenance Manual**

The O/M Manual shall contain but not be limited to the following information:

- Description of each system to ensure that the Employer's staff fully understand the scope and the systems provided.
- Description of mode of operation for each system.
- Diagrammatic drawings indicating principal items of equipment.
- Legend for colour coded services.
- Plant schedule (plant – asset register) system by system of all plant, equipment, etc. stating their location duties, performance figures, what they serve within the building. Each item must have a unique number cross-referenced to the as built/diagrammatic drawings and schedules.
- The name, address and telephone number of the manufacturer of every item of plant and equipment together with catalogue numbers.
- Manufacturer's technical literature for all equipment assembled for the project, including detailed drawings, electrical circuit details and operating and maintenance instructions.
- Copies of all test certificates (including but not limited to electrical circuit tests, corrosion tests, type tests, works tests, start and commissioning tests for all equipment.
- Copy of all manufacturers guarantees, warranties and maintenance agreements offered by sub-contractors and manufacturers.
- Start up and shut down instructions.
- Control sequence for all systems.
- Schedules of all fixed and variable settings established during commission.
- Procedures for seasonal changeovers.

- Recommendations for preventative maintenance frequency and procedures to be adopted to ensure the most efficient and environmentally beneficial operating of the system. Repair, replacement and destruction, recycling and disposal of item of equipment.
- A list of consumable items.
- A list of recommended spares to be kept in stock over the duration of the contract/agreement and the client there after being those items subject to wear and deterioration and which may involve extended deliveries when replacements are required at some future date.
- Procedures for fault finding, re-commissioning and continuous/ on-going commissioning to optimise and get the maximum systems and environmental efficiency.
- Emergency procedures including telephone numbers for emergency services.
- As built mechanical drawings showing all systems, plant, piping, ductwork etc. All sizes of tray, trunking and their route shall be indicated. The planned designed or allowed flexibility of the system shall be clearly documented.
- All services that are buried in the structure shall be clearly indicated on the drawings along with precise position of entry points of services.

The Contractor shall prepare a complete set of Vendor data for all the equipment and systems that he installs in the building.

The mechanical services operations and maintenance manual shall be split into the following sections: -

- General description.
- Heating system.
- Water Services.
- Gas services.
- Ventilation and AC services.
- Protective services.
- As-installed drawings.

The General Description section of the mechanical manual shall provide a general description of the overall mechanical installation and shall include manufacturers data sheets for equipment which is common to all services such as pipes etc

The Heating system section of the mechanical manual shall include manufacturers workshop drawings and operating and maintenance instructions for the following systems: Boilers, Radiators, Unit Heaters etc Pumps, Control system etc Copies of test and commissioning certificates shall be provided for each system

The Water Services section of the mechanical manual shall include manufacturer's workshop drawings and operating and maintenance instructions for the following systems: Water Tanks, Boosters, Filtration Plant etc Copies of test and commissioning certificates shall be provided for each system

The Gas services section of the mechanical manual shall include manufacturer's workshop drawings and operating and maintenance instructions for the following systems: Gas detection, Storage vessels etc Copies of test and commissioning certificates shall be provided for each system

The Ventilation and AC services section of the mechanical manual shall include manufacturers workshop drawings and operating and maintenance instructions for the following systems: Fans, AHU's, AC Units, Pumps, Control system etc Copies of test and commissioning certificates shall be provided for each system

19 HANDOVER

19.1 Introduction

Under this section the Contractor shall include for the hand over and for the instruction of the Employers staff on the operation and maintenance of the various components forming the Mechanical Services Installations.

19.2 Hand-Over Certificates

Upon notice from the Main Contractor of his intention to hand over buildings or parts of buildings, the Contractor shall complete a certificate stating that all tests, commissioning certificates have been completed to the satisfaction of the Employers representative and that installations are complete and safe to operate.

The Engineers shall carry out an inspection and advise the Employers commissioning officer as to the condition of the installation. The Engineers, shall, if required, have tests carried out by the Contractor to demonstrate the performance of any part of the installations.

When installations have been completed to the satisfaction of the Engineers, the hand-over certificate shall be countersigned and the installation shall be deemed to be at Practical Completion stage.

A schedule of all outstanding work and snags shall be attached to this certificate and a programme agreed for its completion.

19.3 Instruction of Employers Staff

The Contractor shall provide for the instruction of the Employers staff on the operation and maintenance of the various components forming the installation.

The Contractor shall prepare a full and detailed handover schedule detailing all systems to be demonstrated to the client, the time scale of the handover and demonstration and recommended attendees, etc. All this information shall be submitted in draft to the Engineer and the client for comment.

When nominated suppliers' appointments include for instruction of the Employers staff, the Contractor shall be responsible for ensuring that such instruction is completed satisfactorily. The Contractor shall ensure, before placing an order, that this is made clear to the Specialist Supplier.

The contractor's supervisor and a representative from each specialist supplier shall be present for instruction of the employer's staff for each individual system.