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Cahir Market Centre

**A.5.1.2 MECHANICAL
GENERAL SPECIFICATION**

TENDER ISSUE

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1. GENERAL WORKMANSHIP REQUIREMENTS FOR ALL PIPE WORK

1.1. GENERAL

All components should be inspected carefully before installation. If any components are damaged or defective, they should be replaced before installation.

Protect open pipe ends wherever work is suspended during construction to prevent foreign bodies entering and lodging therein. Use cast malleable iron caps or other methods for protection.

The ends of all cut pipes are to have all burrs removed and be clean and square.

When jointing and fixing ensure allowance is made for building movement and thermal expansion.

Jointing materials should not impinge on the internal bore of pipes, fittings or appliances. Only fittings intended for the purpose should be used for forming junctions.

Ensure that no opportunity exists for electrolytic corrosion or galvanic action within the installed system by avoiding contact between dissimilar materials which may introduce this risk. Appropriate means shall be employed to prevent these risks where dissimilar materials are connected.

Adequate access is to be provided in convenient locations for testing and cleaning of pipe-work. Access covers and cleaning eyes should be provided in these locations. During construction all openings where foreign matter could enter the system shall be sealed.

1.2. NEATNESS OF INSTALLATION

All pipes should be installed in a manner that is neat and organised. Pipe-work will be installed plumb for vertical runs and in parallel with the building lines and other service runs (precedence remains however with the gradients required for draining and venting) for horizontal runs.

1.2.1. Pipe-work Spacing

Locate group of pipes parallel to each other. Ensure that there is adequate space for maintenance of all pipe-work joints, valves etc.

Ensure that the following clearances are adhered to in installing all pipe-work:

Between	And	Clearance (mm)
Exposed or Boxed Out Pipeline - Insulated or Un- insulated	Wall finish	25
	Ceiling finish or soffit	50
	Floor finish	150
Insulated pipeline	Adjacent service runs	25
Un-insulated pipeline	Adjacent service runs	50
Adjacent pipelines	Both un-insulated	150
	One un-insulated	75
	Both insulated	25

1.2.2. Draining of System

All pipe-work systems should be fully drainable at all low points, this should be accommodated by grading of the pipe-work installation and the use of eccentric reducers and tees

1.2.3. Test Plugs

Test plugs are to be water tight (manufacturer: mechseal, binder or approved equivalent) and are to be provided at all pipe-ends and any other locations required for commissioning of the system.

1.2.4. Accommodation of Thermal Expansion and Contraction

The pipe-work system must be able to accommodate thermal expansion and movement. This will generally be achieved by arrangement of the supports and fixings allowing the system to flex at changes in direction and move at branch connections. For straight lengths of pipe-work greater than 20metres expansion loops (or bellows where space dictates) are to be provided. Axial movement through expansion is to be accommodated through the correct selection of pipe-rings and clips.

1.2.5. Supporting of Pipe-Work

Pipe-works supports will be supplied and installed as required by the pipe-work installation in a material that is compatible with the pipe-work material. These supports in addition to all equipment, appliance and fitting accessories will be installed in a manner that does not introduce undue strain to the pipe-work.

1.2.6. Reducers, Enlargers, Pipe fittings, bends/swept tees

To mitigate the risk of the build-up of air bubbles in the pipe-work system eccentric reducers and enlargers shall be installed on horizontal pipe-runs and concentric reducers and enlargers on vertical pipe-work runs. In both cases easy transition is to be employed with the included angle at a maximum of 30o.

Bends and swept tees are to be used where practical, square elbows will not be accepted. Square tees are to be installed at draining and venting points.

Bushes are only to be used at fittings that require a non-standard size or at radiators and in these cases bushes are to be eccentric with an aspect ratio within two sizes otherwise a reducing fitting is to be used.

1.2.7. Valve Keys/ Loose Items

If any valves do not have levers or hand wheels they will be provided with a minimum of 4No. keys. A receipt (signed by client) is to be provided to the Employer's Representative confirming that these keys have been handed over to the client at handover stage.

1.2.8. Fabricated Junctions

Only if written approval is received from the Employer's representative can fabricated fittings or junctions be used.

1.2.9. Pipes passing through walls and floors

Purpose made sleeves will concentrically enclose all pipes passing through walls, floors, partitions or other building elements. If the pipe-work is visible masking plates are to be installed.

1.2.10. Pipework Passing through external walls

For all services exiting through an external wall an air-tight sealer must be used – the use of expandable foam is not acceptable as a sealant.

1.2.11. Sleeves for Pipes

The following applies to pipe sleeves where the insulation does not carry through the sleeve. The sleeve is to be of the same material as the pipe but 1-2 sizes larger. Sleeves are to be installed flush to the building and are not to support the pipe-work. A 100mm protrusion is to be installed above floor finish where floors are to be washed down.

1.2.12. Sleeves for Pipes Passing through fire barriers

Where pipe-work passes through a fire barrier the space between the pipe-work and the insulation/sleeve is to be filled tightly with a non-flammable, fire –resistant material to form a fire/smoke stop of the same rating as the fire barrier. A cold mastic seal of minimum 12mm is to be applied at both ends within the seal.

1.2.13. Distribution Header Caps

All headers are to be capped/terminated with bolted removable flanged connections.

1.2.14. Temporary plugs, caps and flanges

During the process of installation plugs, caps or bulk flanges in suitable material are to be installed in all open ends to prevent ingress of foreign matter. Proof that fouling has not occurred will be required where these precautions are not followed by strip-out of the length of pipe-work adjacent to the open end.

1.2.15. Pipework Storage on site

All pipe-work stored on site must be sealed at both ends (unless stored in a sealed compartment) and must be raised a minimum of 300mm above floor level.

1.2.16. Pipe-work Removal from Site

All unused fixings and services will be removed from site on completion of the project.

1.2.17. Drilling

Holes are not to be flame-cut in metal work. All holes are to be drilled squarely.

1.3. CONNECTING PIPE-WORK OF DIFFERENT MATERIALS

The following methods are to be used:

Connections between Pipes of Different Materials		
Main Pipe-work Material	Connecting to	Method
Plastic	All other pipe-work Materials	A watertight joint is to be formed using approved methods and connectors as recommended by the plastic pipe-work manufacturer.
Copper	Clay/Concrete sockets	A watertight joint is to be formed and neatly finished using a caulking bush (brazed on), bitumenised yarn and 1:3 cement:sand mortar
Copper	Cast Iron Sockets	A watertight joint is to be formed and neatly finished using a caulking bush (brazed on), bitumenised yarn and an approved caulking compound
Copper	Cast Iron	Using purpose made copper to iron connectors

1.4. FIXING PIPE-WORK TO THE BUILDING

Take the following precautions when fixing to listed elements:

Precautions when Fixing	
Element	Precautions to be Followed
Re-inforced Concrete	Avoid fixing through re-inforcement
Brick-work	Avoid fixing to unsound material or mortar
Timber Rails	Hole should be drilled through timber rail and fixing with bolt, back plate, washer and loose nut to fix equipment, brackets and supports
Hollow Stud, Tile , Block Walls	Where there is access to rear of wall, hole should be drilled through wall and fixing with bolt, back-plate, washer and loose nut used to fix equipment, brackets and supports. Where there is no access to rear of wall, hole should be drilled and screw anchor type fixing or gravity type toggle fixing to fix equipment, brackets and supports.

Concrete, brick-work or Block-work	Wood screws in plugs are to be used to fix equipment, brackets and supports. Drill holes and fix using steel bolts of grouted bolt type or expanding bolt type fixing.
Metal-work	Drill holes and fix equipment, brackets and supports using set screws or bolts complete with washers, shake proof washers and loose nuts.
Steel-work and Concrete Structures	Provide manufacturer's information on recommended fixing. Obtain approval for any fixing to structure steel work and concrete structures. Generally use proprietary fixings to structural steelwork and concrete structures. Obtain approval to cut holes in structural steelwork or concrete structures or weld to structural steelwork.

1.5. PAINTING

In the unlikely event of pipe-work being exposed the following pipe-work coatings are to be used at fittings.

All coatings to be applied by (or purchased pre-applied by) the Mechanical Services Specialist.

Hot, Cold, and Mains Water Services Location	Coating Of Pipes And Fittings
Exposed within shower areas	Pre-coated chrome plated
Exposed, un-insulated pipework	Paint with undercoat (Zinc chromate primer) and overcoat to match surrounding surfaces. All paint to be neat, drip and ripple free and to be suitable for the temperature of the pipe to which it is applied.
Insulated pipework	Uncoated
Concealed pipework	Uncoated

Gas Pipework Location	Coating Of Pipes And Fittings
All areas	Paint with undercoat (Zinc chromate primer) and overcoat in yellow paint. All paint to be neat, drip and ripple free and to be suitable for the temperature of the pipe to which it is applied.

Heating Pipework Location	Coating Of Pipes And Fittings

Un-insulated Pipework - Visible	Paint with undercoat (Zinc chromate primer) and overcoat in paint. All paint to be neat, drip and ripple free and to be suitable for the temperature of the pipe to which it is applied.
Insulated Pipework	Paint with undercoat (Zinc chromate primer). Recoat fittings and welds within four weeks of their installation. Wire brush welds before painting.

The Painting Contractor shall furnish all materials, labour and equipment necessary to prepare metal surfaces and apply paints and coatings in accordance with this specification.

The Contractor shall be responsible for monitoring progress and quality of all protective coating work. He shall identify and repair any defective work at his own expense. The Contractor shall ensure that all equipment used shall be in safe operating condition,

Pressure equipment shall have current insurance test certificates, safety relief valves, pressure gauges, regulators, etc. Abrasive blasting nozzles and hoppers shall be earthed. Operator's hood/headgear shall conform to safety requirements

Prior to painting all steel surfaces are to be cleaned and prepared for painting using the procedures outlined in IS EN ISO 8503 and IS EN ISO 4618-3. Metal surfaces are to be cleaned and degreased with all mill and weld scale removed prior to degreasing before painting.

A coat of red oxide primer should be applied to all steel pipe-work as work progresses, before application of the primer the steel must have all scale, rust and temporary protective coatings removed. This can be achieved with the use of chipping, wire brushing or approved solvents as appropriate.

1.5.1. Painting Materials

Use the following materials as appropriate:

Painting Materials	
Area to be Used	Material
Bare Woodwork	Solvent borne priming paint to latest version or superseding standard of BS 7956
Bare Iron and Steelwork	Red Oxide priming paint
Bare ferrous and non-ferrous metals	Zinc chromate priming paint
Galvanized steel or composite wood/metal components.	Calcium Plumbate priming paint to latest version (or superseding standard) of BS 3698
Previously primed or painted surfaces before the application of finishing coats.	Undercoating paint
Previously primed or painted/undercoated surfaces.	Gloss finishing paint

Specialist coatings requiring resistance to acids, alkalis, oils, solvents, abrasion or high humidity.	Epoxy resin paint
Structural steelwork, storage vessels, heated metallic surfaces and similar applications where moisture and heat resistant properties are required.	Aluminium paint to latest version (or superseding standard) of BS 388
Making good damage to previously galvanized surfaces and protection to galvanized materials modified during installation	Cold galvanizing paint
Bare iron and steelwork where electrical conductivity has to be assured	Zinc-rich metallic to latest version (or superseding standard) of BS 4652
Moisture resistant protection to metal surfaces where decorating appearance is not important.	Black tar-based paint to latest version (or superseding standard) of BS 1070
Protection to iron and steel, particularly pipelines and fittings for use in contact with potable water.	Bitumen based coatings for cold application to latest version (or superseding standard) of BS 3416
Applications to surfaces over 70oC	Heat resistant paints

Note: Bitumen based coatings for cold application to BS 6949 are not to be used in contact with potable water.

1.5.2. Quality Measures for Paint

In general paints are to be quality and type to suit application.

Gloss finishing paints are to be of machine finish grade having high adhesion and high resistance to solvents, mineral oils, cutting oils, detergents, chipping and impact damage.

Primers are to have good adhesion, covering power, rust-inhibiting and grain filling properties.

1.5.3. Painting Workmanship

All paints purchased for use as described in this specification shall be stored in strict accordance with paint manufacturer's instructions. The paint manufacturer's instructions shall be followed explicitly for surface preparation and applying their products, and shall be considered as part of this specification. Where any doubt exists the paint manufacturers to be contacted for their recommendations. The Contractor shall adhere to the manufacturer's instructions.

Daily samples of the paint in use may be requested to be taken and are to be retained by the Contractor, for six months, together with samples of each batch of paint as supplied by the paint manufacturer.

Ensure paints are applied in accordance with the latest version (or superseding standard) of BS 6150 and all manufacturer's recommendations.

The paint manufacturer shall show clearly the following information on each container of his product -

- Full name of product (to agree with that on product data sheet).
- Any product code number (to agree with that on product data sheet).
- Colour of product with applicable colour number to British Standard 4800 or approved RAL F3 equivalent.
- Date that container was sealed (month and year).
- Life of contents from date seals (e.g. use with one year).
- Flash point of contents in degrees C (and degrees F in brackets).
- Batch number

The whole of the workmanship shall be the best of their respective kinds and the work shall be carried out to the entire satisfaction of the Architect and/or Employer, and shall be subject to the guarantee provided by the Contractor confirming a guaranteed quality of workmanship and materials. A complete set of product technical, safety, health and environmental risk and application data sheets for all painting materials shall be submitted to the Architect prior to the site delivery and commencement of work. All painting materials in the Contractor's possession shall be available at any time to the Architect for inspection or sampling.

1.5.4. Weather Conditions for Painting

Paint should not be applied during times when a damaging effect may be had on the paint or finish by weather, temperature, humidity or other conditions.

1.5.5. General Painting Application Constraints Requirements

Painting shall not take place when any of the following conditions prevail:

- When it is raining.
- When heavy fog or mist are present.
- When the relative humidity is greater than 85% and/or when the surface temperature cannot be maintained at least 3°C above the ambient dew point.
- When the steel temperature is below 3°C (or 5°C for two-pack epoxies or polyurethanes).

Paint shall not be applied to steel which is at a temperature of over 50°C unless the paint is specifically formulated for the application at the proposed temperature. In all cases the surface being painted must be clean and dry before and during all painting operations.

The first prime coat shall be applied not more than four hours after surface preparation. Where additional coats of paint are required the drying or curing time between coats will be in accordance with the minimum drying time recommended by the paint manufacturer for the type of paint in use. In general 24 hours should be allowed in between coats. Primers and undercoats shall be of different colours to provide a visual check that surfaces have been completely covered.

Painting may be suspended at the discretion of the Architect due to wind speed or when adverse weather conditions are likely to develop before painting could be carried out, or for other reasons deemed inappropriate to proceed.

The Contractor shall provide with his technical submission his recommended painting application methods where they may deviate from this specification or the Paint Manufacturer's recommended practice of application, for approval by the Architect.

It is also the responsibility of the Contractor to ascertain from the Paint Manufacturer the correct pressure, tip size etc, to be used for spray application and these requirements shall be carefully followed. Particular care shall be taken to ensure that sharp edges, welds, irregular shaped structures, pipes and inaccessible areas are adequately coated to the full film thickness. To achieve this, sharp edges and welds shall be pre-coated (stripe coated) immediately prior to application of each coat of paint unless otherwise stated in the paint specification or by the Architect.

1.5.6. Off Site Paint Finishes

Where paint finishes are applied off site by component manufacturers it should be ensured (where possible) that these spray applied.

If paint is applied on site ensure finish shows no excessive brush marks, grinning, runs, sagging, ropiness or other application defects

1.5.7. Cold Galvanizing

If damage occurs to galvanised components due to cutting, drilling, welding etc. 2No. coats of galvanizing paint should be applied to the required thickness.

1.5.8. Detailed Painting Specifications

New Carbon/Mild Steel Surfaces (Temperature range - 20°C to 120°C). Vessels, tanks, pipework, support steelwork, brackets, flanges, valves, piperacks, skid mounted units, pumps, motors, steel doors, etc.

- Blast clean surface to SA 2.5 per ISO 8501-1-1988 - Profile 75 microns maximum.
- Apply one coat of 2 pack epoxide zinc rich primer to a minimum dry film thickness of 75 microns above the peaks of the profile (Temazinc 99 or approved equivalent).
- Stripe coat all sharp edges, sections, welds etc with one coat of highbuild epoxy (Temashield EOF 200 or approved equivalent).
- After the appropriate curing period as specified by the Coating Supplier apply one full coat of two pack epoxy highbuild intermediate at a minimum dry film thickness of 350 microns (Temashield EGF 100 or approved equivalent).
- If the above applications are carried out at works before delivery to site then the following coats should be applied on site within the overcoating times laid down by the Paint Manufacturer.
- Stripe coat all edges, I sections, welds etc with one coat of highbuild epoxy (Temashield EGF 200 or approved equivalent).
- Apply one full coat of two pack epoxy high build at a minimum dry film thickness of 350 microns (Temashield EGF or approved equivalent).
- After the appropriate curing times apply one full coat of a two pack aliphatic polyurethane at a dry film thickness of 50 microns. (Temathene PLV or approved equivalent).

Colour coding of above system to be agreed with Employer prior to commencement of painting.

1.6. IDENTIFICATION

1.6.1. Pipe-work Identification

Primary Identification:

In order to identify pipe-work 300mm wide colour bands to the latest version (or superseding standard) of BS1710 should be applied to all pipe-work:

- Once in each and every room or enclosed area.
- At intervals not exceeding 15 metres.
- At each and every junction.
- At each and every valve.
- At each and every inspection and access position into service shafts, false ceilings, bulkheads etc.

1.6.2. Secondary Identification:

In addition to the above 50mm wide colour bands identifying circuit, direction of fluid or gas flow, and nominal pipe bore should be applied to all pipe-work. All labels should be oriented for easy reading from the standard position of observation. Transfers of an approved type should be used to apply colour bands.

All labels should be secured so that they do not become disengaged from the pipe-work over time.

1.6.3. Valve Identification

An engraved disc (35mm with minimum 6mm text) with a numerical reference shall be provided for each valve, cock, stop valve, air vent, drain cock etc unless the valve is at a final outlet or termination (i.e. within 2 metres of). The discs shall have a colour coded system to distinguish primary and secondary system valves. Any regulating valves or flow measuring equipment will also have operating instructions included and key parameters engraved as appropriate.

2. FOUL DRAINAGE ABOVE GROUND

2.1. GENERAL

All above ground drainage systems as required for the building shall be supplied and installed.

The installation is to be completed with connections to all sanitary ware as necessary using connectors, traps and other fittings. Access will be provided for maintenance and rodding. Any required access hatches are to be provided by the main contractor.

Care shall be taken in grading the pipe-work to ensure a self-cleansing flow. Pipe-Work shall be installed in accordance with the manufacturer's recommendations. Fittings and

ancillaries shall be by the one manufacturer and compatible with the pipe-work jointed to, in accordance with the methods recommended by the manufacturer.

2.2. INSTALLATION AND WORKMANSHIP

2.2.1. Pipe-Work

Soils and Waste Pipe-Work shall be installed in uPVC pipe-work and ancillaries to B.S. 4514.

2.2.2. Pipework Materials

Pipe work will be as follows:

Pipe-work Material	
Size	Material
<76mm Diameter	Grey/Black uPVC with plain ends
>76mm Diameter	White Polyethylene with plain ends

2.2.3. Pipe-Work Support

All Soils / Waste pipework shall be fixed with pipe supports to the building structure, independent of all plant and equipment. Supports shall be of a proprietary manufacture or purpose made and shall be approved by the engineer. Supports should be provided as per the following spacing table:

Support Spacing				
Pipe Bore (mm)	UPVC		Polyethylene	
	Horizontal (m)	Vertical (m)	Horizontal (m)	Vertical (m)
15	-	0.6	0.4	0.6
20	-	0.65	0.4	0.6
25	-	0.75	0.4	0.6
32	-	0.8	0.45	0.7
40	-	0.9	0.45	0.7
50	1.1	1.2	0.55	0.85
65	1.2	1.4	0.55	0.85
80	1.4	1.5	0.6	0.9
100	1.5	1.7	0.7	1.1

Notes:

- Where other materials are specifically specified e.g. copper the spacing shall be as indicated under general services supports.
- A diagonal brace shall be fitted at the socket of each length of horizontal soil pipe.
- On vertical soil pipes and on waste pipes a support clip shall be fitted at each socket and at intervals set out in the above table.
- Where bends are used to accommodate thermal movement, pipe clips shall be located on either side of such bends in such a way as to permit small deflections to take place.

5. Small diameter discharge pipes connected directly to the stack at ground floor level shall have close supporting anchor brackets on the boss branches.

In special cases where a complete solvent weld system is required on soil installations this will be referred to in the particular specification.

Vertical support spacing

When using mechanical joints or end load capable flexible couplings, the self-weight and pressure loading of the system should be checked against the manufacturer's recommendations. If using non-end load capable flexible couplings adequate pipe support should be ensured.

The minimum support distance should be used where supports are used on a length that has multiple diameters.

Pipe Supports

Supports shall be installed at the intervals and by the methods recommended by the manufacturer. Supports shall be arranged as close as possible to joints and bends. Each support shall carry a due proportion of the pipe weight. Vertical pipes shall be supported adequately at the base in order to withstand the total operating weight of the riser. Multiple riser pipes shall not be secured individually to the structure but shall be supported from multiple assemblies fabricated from Unistrut components and suitable for building in or otherwise securing to the structure.

Multiple horizontal pipe runs shall not be secured individually to the structure but shall be supported from multiple assemblies fabricated from Unistrut components and suitable for building-in or otherwise securing to the structure, together with adjustable mild steel hangers with swivel joints. Pipe rings shall be Flamco or approved equal.

Where pipe-work is supported below concrete slabs, patented concrete inserts shall be used to accept cadmium plated threaded rod. Where piping is supported below steel work Linaptors or other patented clamping system, approved in writing by the Engineer shall be used.

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

Supports shall be installed at the intervals and by the methods recommended by the manufacturer.

2.2.4. Cleaning of Pipe-work

All pipe-work should be cleaned and pipe-work solvent removed.

2.2.5. Joints and Fittings

Joints and Fittings Installation		
Type	Preparation	Installation

Solvent Welded Joints (Use solvent joints generally. Use ring seal joints at expansion joints and elsewhere if required)	Plain ends to be cut square	In accordance with manufacturer's instructions.
Fusion Joints	Square cut plain ends. Form pipe ends for socket type joints.	In accordance with fitting manufacturer's instructions
Mechanical fittings for polyethylene pipe	Ensure that cut ends are square. Check wall thickness/pressure rating of fitting.	Assemble fittings in accordance with manufacturer's instructions.

2.2.6. PVC Anchors

A mild steel channel section shall be attached or grouted into the building structure to which pipe-work shall be clamped (with a polypropylene strip between pipe and mild steel section) using PVC coated over straps, or clamps.

2.2.7. Pipe-work passing through Fire Barriers

Where pipe-work passes through fire barriers fire collars which crush the pipe in the event of a fire shall be provided.

2.2.8. Routing of Pipe-work

Pipe routes should be installed so that they are as short as practicable with the minimum number of bends. The wet section of soil stacks should not contain any bends unless shown otherwise on drawings.

Square type door access points should be provided:

- Where indicated on drawings
- At the foot of all soil and ventilation pipes
- Above flood level on each floor

Access points and horizontal anti-siphon pipes should be located above fitment flood level where practicable

2.2.9. Fittings for Pipe-work

All fittings shall be of the same material as the relevant pipe-work. The use of formed fittings is only to be carried out with approval from the Employer's Representative where manufacturer's standard fittings are not available

Where pipe-work size increases or decreases easy transition type fittings should be used with a maximum inclined angle of 30°. For solvent cement all joints with the exception of traps will be socket and spigot type.

Sanitary Fittings

Fix all pipes and fittings in strict accordance with Manufacturer's Instructions. All necessary pointing materials, fixings and accessories to be as recommended by the Manufacturer. Sanitary Fittings shall be supplied and installed by the Main Contractor.

Traps for sinks, wash hand basins, and showers

Polyethylene "S" type traps, with screwed connections for easy cleaning, will be supplied and installed for all sinks, wash hand basins, showers etc.

Traps for WC's

uPVC "S" type traps, with screwed connections for easy cleaning, will be supplied and installed for all WC's. These will be bedded in waterproof jointing compound and fixed a resilient washer between the appliance and the back nut.

Blank Caps and Cleaning Access

Blank caps and cleaning access shall be provided at all locations where rodding access is necessary for cleaning or removal of blockages.

Vent Cowls

Vent Cowls shall be provided on all vent outlets fitted with a guard or domical cage of durable material or other cover which does not restrict the flow of air unduly.

Connections to Main Contractors Drainage

The Contractor shall make off all soils and waste connections to the sockets provided under the Main Building Contract and which generally are to finish flush or close to the floor.

Overflows from WC Cisterns.

All Water Closets and other flushing cistern overflows shall be run to outside.

Floor Drains

Floor Drains shall be Wade 2000 or approved equal. Sample of drain is to be submitted to the Architect for approval prior to ordering.

2.3. TESTING AND COMMISSIONING

Environmental testing is to be carried out for a full range of operational conditions and duties on the system to prove performance.

The Works shall be installed and tested, to the requirements of the relevant Local Authority. All sanitary pipe-work installations shall be tested in accordance with B.S. 5572. Inspections and tests should be carried out as the work proceeds, to ensure that all work is free from defects, is sound and unblocked, before building work enclosing it proceeds.

Completed Works should be carefully inspected to see that no foreign matter is lodged or has adhered within the pipes and that no jointing materials projects therein. It should then be tested for soundness.

Recording of Performance tests

A well organised, systematic record of performance tests should be kept by the contractor with a copy provided in the O&M Manuals for the client.

Trap test requirements

Ensure there is retention of 25 mm water seal in every trap, and that no air breaches the trap seal when performance is tested.

2.3.1. Standards and Regulations

The latest versions (or superseding standards) of the following standards are to be adhered to:

Standard	Relates to
BS 4514	UPVC Pipework
IS EN 1565 BS 5288	Polyethylene fittings
IS EN 1329 BS 5288	UPVC Fittings
IS EN 1519 BS 5288	Polyethylene pipework and fittings
IS EN 1565	Polyethylene fittings
IS EN 12056	Testing of sanitary pipework
BS 5080	Testing of fixings
IS EN 274	Traps for wash hand basins, sinks, and showers
IS EN 997	Traps for WC pans
B.S. 437	Specification for cast iron spigot and socket drain pipes and fittings
B.S. 6087	Specification for flexible joints for cast iron drain pipes and fittings and for iron soils, waste and ventilating pipes and fittings
B.S. 416	Specification for cast iron spigot and socket soil, waste and ventilating pipes and fittings.
B.S. 5572	Code of Practice for Sanitary Pipe-Work
B.S. 5255	Specification for thermoplastic waste pipes and fittings.
B.S. 4514	Specification for unplasticised PVC soil and ventilation pipes, fittings and accessories
	The Institute of Plumbing Design Guide.

3. INTERNAL WATER SERVICES**3.1. GENERAL**

All water services (mains, hot, hot return and cold water) as required for the building shall be supplied and installed.

The installation is to be completed with connections to all sanitary fittings as necessary using connectors, traps and other fittings.

Access will be provided for maintenance. Any required access hatches are to be provided by the main contractor.

All water pipework and fittings shall be suitable for the distribution of potable water.

3.1.1. Venting of Pipe-work

A means of venting all pipe-work systems at all high points is to be provided. This will be in the form of automatic air vent valves at all high points except for those agreed with the Employers Representative. Access to all air vents is to be co-ordinated with the main contractor before any work begins.

3.1.2. Isolation and Regulation Valves

Isolation valves are to be supplied and installed in the following locations in grouped, aligned manner with levers facing the user:

- At the base of all risers and drops except where only one fitting is served
- Use ballofix valves at all connections to fittings
- Use ballofix valves at all connections of hot water secondary return pipes to hot water pipework
- Before all ball cocks or other equipment connections

Access will be provided for maintenance. Any required access hatches are to be provided by the main contractor.

3.1.3. Cleaning of Pipe-work

All installed pipe-work is to be cleaned and degreased prior to concealment or handover.

3.1.4. Manufacturer's Instructions

Manufacturer's instructions are to be followed for the storage, preparation, and installation of all equipment, fittings, and materials.

3.2. INSTALLATION AND WORKMANSHIP

3.2.1. Pipe-work

Copper pipe-work with plain ends is to be supplied and installed for all internal water services unless other materials are specifically requested on the drawings.

3.2.2. Insulation of Pipe-work and Fittings

A specialist contractor shall be used for the supply and installation of insulation. All insulation shall be manufactured in compliance with the latest version (or superseding standards) of IS EN 9000-2. All insulation is to be installed in a neat manner and be undamaged at handover. The entire installation shall be strictly in accordance with B.S. 5422: 1977; B.S. 5970: 1992; B.S. 3958 ~ Parts 3 and 4, and B.S. 476 ~ Parts 4, 6 and 7.

Insulation is to be provided on all pipe-work, joints and valves.

All pipe-work insulation is to be foil-faced mineral wool as follows.

Maximum thermal conductivity: 0.025 W/moC (at a mean temperature of 100oC).

Density: 80-120kg/m3.

Mineral wool insulation thickness shall be as follows:

Mineral Wool Insulation Thickness			
Pipe Size (mm)	Hot Water, & Hot Water Return (mm)	Mains & Cold Water (mm)	External Pipework (mm)
10	23	20	50
12	24	20	50
15	26	20	50
22	40	20	50
28	40	20	50
35	40	20	50
42	45	25	50
54	50	25	50

Rigid Thermal Insulation on Pipework in Boiler Room:

Domestic Water Services

All pipework in the Boiler Room shall be insulated with thicknesses as described in the General Specification by means of rigid sections with foil or PVC backing as required and band finish. Insulation shall comply with BS5422:2001. It shall be Class O or Euroclass B, low smoke to EN13823, EN ISO 11925-2.

- **Domestic Water External Piping Installation**
Install Foil Back, Rigid insulation, sealed and lapped joints, to thickness listed below. Wire brush all pipes. Painted with 2 coats of red oxide paint. Wrapped in Oppanol Sheeting. Insulated. Clad in 18 gauge aluminium. All valves, flanges, support mount positions to 150mm below the pipe shall likewise be insulated and cladded. Heat trace tape applied and installed to the manufacturers requirements.
- **Domestic Water Plantroom Piping Installation**
The whole of the piping in the plant rooms is insulated as previously specified. Contractor shall ensure that the insulation is in sections and, on completion, the insulation is clad with 18 gauge aluminium, fixed with self tapping screws. The contractor shall ensure that the body of valves is insulated with purpose made insulated valve bags arranged to facilitate maintenance and that pump bodies are encased in formed removable metal casings with fasteners lined with the same insulation as fitted to adjacent pipes; spaces within casings must be filled with removable bonded flexible insulating material.
The contractor shall ensure that all pipework insulation and methods of application whether mounted externally or internally complies fully with the requirements within the following BS 5422:2001 and BS 5970, all thermal insulation buried within the ground complies with BS 4508 and the thermal properties of the insulating materials comply with the provisions as described in IS EN 13166:2001 AMD:2004, BS 3958 and BS 5608 as appropriate.

Further guidance is available in:

- BS 5422:2001 Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range of -40°C to $+700^{\circ}\text{C}$
- BRE Report No 262 Thermal insulation: avoiding risks, 2002 edition In assessing the thickness of insulation required to meet the provision, standardised conditions should be used in all compliance calculations based in this instance on a horizontal pipe at 60°C in still air at 15°C .

Heating Services

All pipework in the Boiler Room shall be insulated with thicknesses as described in the General Specification by means of rigid sections with foil or PVC backing as required and band finish. Insulation shall comply with BS5422:2001. It shall be Class O or Euroclass B, low smoke to EN 13823, EN ISO 11925-2.

- Domestic Water Internal Piping Installation
Install Foil Back, Rigid insulation, sealed and lapped joints, to thickness listed below.
Heating LPHW Internal Piping Installation
Install Foil Back, Rigid insulation, sealed and lapped joints:
Sizes up to and including 40 mm. bore - 25 mm. thick
Sizes over 50 mm and including 50 mm - 40 mm. thick
- Heating External Piping Installation
Install Foil Back, Rigid insulation, sealed and lapped joints, to thickness listed below.
Wire brush all pipes. Painted with 2 coats of red oxide paint. Wrapped in Oppanol
Sheeting. Insulated. Clad in 18 gauge aluminium. All valves, flanges, support mount
positions to 150mm below the pipe shall likewise be insulated and cladded.
- Hot LPHW Plantroom Piping Installation
The whole of the piping in the plant rooms is insulated as previously specified. Contractor shall ensure that the insulation is in sections and, on completion, the insulation is clad with 18 gauge aluminium, fixed with self tapping screws. The contractor shall ensure that the body of valves is insulated with purpose made insulated valve bags arranged to facilitate maintenance and that pump bodies are encased in formed removable metal casings with fasteners lined with the same insulation as fitted to adjacent pipes; spaces within casings must be filled with removable bonded flexible insulating material.
The contractor shall ensure that all pipework insulation and methods of application
whether mounted externally or internally complies fully with the requirements within the following BS 5422:2001 and BS 5970, all thermal insulation buried within the ground complies with BS 4508 and the thermal properties of the insulating materials comply with the provisions as described in IS EN 13166:2001 AMD:2004, BS 3958 and BS 5608 as appropriate.

Further guidance is available in:

- BS 5422:2001 Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range of -40°C to $+700^{\circ}\text{C}$
- BRE Report No 262 Thermal insulation: avoiding risks, 2002 edition In assessing the thickness of insulation required to meet the provision, standardised conditions should be used in all compliance calculations based in this instance on a horizontal pipe at 60°C in still air at 15°C .

3.2.3. Protection of External Pipework

Polyisobutylene (PIB) protection is to be provided on all external pipe-work. The following installation guidance shall be adhered to:

The PIB sheeting is to be used to wrap (lapping by a minimum of 50mm at all joints) all pipe-work and fittings. Joints are to be installed so as to prevent the ingress of water, they are to be solvent welded and support with banding as per manufacturer's instructions.

Exposed external valves are to be installed with valve jackets. Any external above – ground pipe-work is to be installed with trace heating with control panels and all other necessary equipment to prevent freezing.

3.2.4. Maintaining Integrity of Vapour Barriers

Any and all vapour barriers must have their integrity maintained. Any damage to such vapour barriers shall be repaired as per manufacturer's instructions. The maximum permeance value for vapour barriers shall be 0.05g/sMN.

3.2.5. Insulation Materials

All building services insulation materials are to be CFC and HCFC free (zero ozone depletion potential) and must maintain their thermal performance for a minimum of twenty five years.

Insulation is to be kept dry at all times and surfaces are to be fully dry before installation of insulation.

Urethane foams, Extruded polystyrene, Polyisocyanurate foam and Polyethylene foam are not to be used.

Pipe-work installed together must not be insulated in one enclosure, each pipe is to be insulated separately in a neat manner with all joints and corners uniform and all overlaps even, parallel and arranged to fall on the back of the pipe where possible. .

Joints are to be close butted together and secured with adhesive or matching class 'O' tape (> 50mm wide) on all overlap edges in all directions.

Fittings are to be insulated to the same standard (with the same taping arrangements) as connecting pipe-work.

Where a vapour seal or fibre containment is necessary a taped seal should be provided between the exposed insulation membrane and the pipe surface.

Class 'O' foil tape shall be used where pipe support inserts that have integral vapour barriers abut insulation in order to maintain the integrity of the vapour barrier or containment

Phenolic foam pipe supports shall be used where insulation runs through pipe supports. Ensure that the integrity of vapour barriers is maintained.

All valves, flanges and other fittings on insulated pipe-work are to have equivalent vapour barrier and insulation performance to pipe-work.

3.2.6. Fire Protection

All insulation shall be compliant with Euroclass A1 and will have a maximum smoke obscuration rating of 5% tested in accordance with the latest version (or superceding standard) of IS EN ISO 5659-2.

When the installation is complete it shall have a surface finish that meets the requirements of the latest version (or superseding standard) of BS476-7 Class 1 (spread of flame).

3.2.7. Pipe-work Joints

Pipe-work joints are to be installed as follows:

Pipe-Work Joints		
Type	Preparation	Installation
Capillary joints for potable water	Plain ends to be cut square and cleaned with fine steel wool. Plain ends to be reamed until bore is at full bore size.	Specified amount of flux should be used as per manufacturer's recommendations with no excess material used. Joint to be made in adherence with manufacturer's recommendations. Remove flux traces upon completion of joint.
Compression joints (copper pipes – light gauge)	Preparation is to be carried out in compliance with IS EN 1254-2 / BS 864-2. Plain ends to be cut square and cleaned with fine steel wool. Plain ends to be reamed until bore is at full bore size. Include for any additional manufacturer's recommendations.	Joint to be made in adherence with manufacturer's recommendations.
Mechanical Joints (Grooved copper pipes)	Ensure that cut ends are square, free of bumps, dents and score marks and are within manufacturer's tolerances. Form groove in accordance with manufacturer's recommendations. Assemble joint in	Make and seal ensuring gasket is suitable for service. Thoroughly lubricate gasket, externally and internally, using manufacturer's recommended lubricant. Stretch gasket over pipe end and bring pipe ends together. Slide gasket into central position over both pipe ends. Position joint half housings over gasket and

	accordance with manufacturer's instructions.	insert bolts and nuts and electrical continuity clip if required. Tighten bolts to manufacturer's instructions. Check alignment of joint and pipe-work. Use manufacturer's earth continuity clips to ensure compliance with ETCI regulations.
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3.2.8. Masking Plates

Masking plates are to be installed in any location where a non-concealed pipe passes through a wall or floor. The masking plates are to be constructed of a copper alloy and chromium plated. They are to be heavy, split on the diameter and close fitting to the outside of the pipe. The masking plate is to be fixed using chrome raised head fixing screws.

3.2.9. Fabricated Fittings

Only if written approval is received from the Employer's representative, and manufacturer's standard fittings are not available, can fabricated fittings be used.

3.2.10. Spacing of Pipe-work Support

Copper pipe-work shall be supported as per the following table:

Copper Spacing		
Pipe Bore (mm)	Horizontal (m)	Vertical (m)
Up to 15	1.2	1.8
22	1.4	2.1
28	1.8	2.4
32	2.4	3.0
35	2.4	3.0
42	2.4	3.0
54	2.7	3.0
67	3.0	3.0

The minimum support distance should be used where supports are used on a length that has multiple diameters.

3.2.11. Copper Anchors

Anchors shall be designed to resist all axial stresses resulting from flexure of pipe-work and constructed in materials matching or compatible with the supported pipe-work. The design of all anchors shall presume unbalanced forces exist at the anchor point.

Ensure that the structure is capable for transmitted stress. Provide and fix all associated backing plates, nuts, washers and bolts for attachment to or building into building structure. Anchors are to be properly lined up and grouted.

3.2.12. Fittings for Water System

Fittings	
Capillary Fittings For Chrome Plated Copper Tubing, Potable Range	
Material	Copper or dezincifiable resistant copper alloy
Standards	BS 864-2, or IS EN 1254-1
Size range	6 mm to 67 mm
Dimensions	IS EN 1254-1 table 2, or BS 864-2, table 7
Ends	Integral (lead-free) solder ring
Finish	Chrome plated
Tundishes (Copper)	
To Be Provided	To equipment, as indicated, or recommended by equipment suppliers
Construction	Use 3 mm minimum thickness copper sheet. Form sheet into a tapered reducing cone with a minor diameter to suit drain line.
Dimensions	Major diameter nominally 50 mm larger than minor diameter, tapering at approximately 30 degrees.

Valves for Water System:

Valves	
General	
All valves are to be pressure tested at the manufacturer's works. All valves shall be kitemark certified. All valves shall be attached to pipework with screwed fittings. All valves shall be manufactured from a copper alloy	
Stop Valves	
To be provided:	For isolation of pipe-work up to 67mm Diameter
Type:	Lever Operated with Anti-blowout stem.
Manufacturer:	BS BOSS Fig 966S, brass full bore ball valve, WRC approved
Materials	Bronze or DZR copper alloy body Chrome or nickel plated DZR sphere with full bore flow aperture PTFE seals and stem seals
Ends:	Threaded

Ballofix Valves	
To be provided:	For the isolation of pipe-work at final connections to fittings and the connection of hot water secondary returns to hot water services.
Type:	Screwdriver operated with anti-blowout stem.
Materials	Bronze or DZR copper alloy body. Chrome or nickel plated DZR sphere with full bore flow aperture. PTFE seals and stem seals.
Ends:	Threaded
Lockshield Valves	
To be provided:	For isolation of pipe-work where valves should not be tampered with by the end users
Type:	Ball valve – Lockshield. With anti-blowout stem
Materials	Bronze or DZR copper alloy body. Chrome or nickel plated DZR sphere with full bore flow aperture. PTFE seals and stem seals.
Ends:	Threaded
Float Operated Valves	
To be provided:	For cold water storage tank inlets
Type:	Type 3, diaphragm, plastic float valves
Materials	Bronze or DZR copper alloy body
Ends:	Threaded
Check Valves	
To be provided:	Where indicated on drawings
Manufacturer:	Up to 54Dia. HNH 47, 67Dia. and above HNH Ltd. Fig. M651 PN(6/16)
Materials	Bronze or DZR copper alloy body
Ends:	Threaded

3.2.13. Drain Cocks

Drains Cocks	
To be provided:	At all low points in the system that can not be drained through outlets
Type:	Lockshield connection to accept key. Fit outlet with hosepipe connector.
Manufacturer:	HNH Ref 371
Materials:	Bronze body
Ends:	Threaded

Drinking Water System Drains Cocks	
To be provided:	At all low points in the system that cannot be drained through outlets
Type:	Lockshield connection to accept key. Fit outlet with hosepipe connector.
Manufacturer:	ASV Stubbe
Materials	PVC-U
Seals:	EDPM, FPM

3.3. PUMPS

For the required duty of the system pumps are to be selected at or near the most efficient part of their performance curve.

Pumps are to be installed, in a manner where they are supported separately to the pipe-work, in accordance with all manufacturer's recommendations (including the position and orientation of the pump). Adequate access is to be provided for maintenance.

3.3.1. Water booster Pumps

Pumps: Centrifugal multi-stage pumps with mechanical shaft seal and TEFC Squirrel Cage 400/3/50 motors. Pressure Vessel shall be designed for a working pressure of seven bars with replaceable Butyl Rubber diaphragm and sealed-in compressed air cushion. A Schrader Valve shall be provided to 'top-up' the air charge on Site; also a pressure relief valve.

3.3.2. Automatic Control Panel:

Automatic Control Panels shall be a sheet steel, dust-tight, splash-proof enclosure incorporating circuit breakers with overload protection and single phasing prevention. Duty pump selector switch with 'off' position Isolator interlocked with door; 'Test' push buttons for each motor; indicating pilot lights 'Run and Trip' with 'MAINS ON' indicated; flip/flop relay to alternate the duty pump on each start-up; low-suction pressure cut-off switch and alarm fully wired to terminal block. Pumps shall operate together to meet peak demands and shall incorporate dry run protection. Time delay relays shall be provided to over-ride the pressure switches and extend the run period of the pumps.

Pipes and Valves: Inlet and outlet connections shall be fitted with isolating valves. Non-return valves shall be fitted on the discharge side. The set shall be fully piped in Copper Tubing, to I.S. 238:1980 up to 54mm and B.S. 287; Part II, including 54mm and over, with flanged inlet and outlet.

A Pressure Reducing Valve shall be fitted to the discharge side of the Booster Pump Set. The valve shall be the self-regulating type and shall be manufactured by Desbordes, as supplied by Modern Plant or approved equal.

Filters shall be fitted to each of the pump inlets of a suitable grade to prevent silt damage to the mechanical seals on the pumps. The pumps shall be selected to provide the specified duty, downstream of the pump, in addition to any resistance as a result of the filters.

Base Frame: The complete package shall be mounted on common steel frame with holding-down boltholes, fully tested, hydraulically and electrically, and painted with undercoat and hard gloss finish. Unit shall be Wilo packaged booster or equal..

3.4. WATER TANKS

3.4.1. General

All internal fixings, including nuts, bolts, cleats, flanges and stays shall be made from stainless steel. The Contractor shall ensure that dissimilar metals are never used in contact with each other where both are in contact with the water.

All holes in the Tank Plates for fixing rods, bolts, stays and pipe connections shall be made at the manufacturer's works. Pipe connections of 50mm nominal diameter and less shall be parallel and smooth-ended bosses formed in the tank wall material, which is to be thickened out 2mm proud on both sides and with a suitable diameter for standard tank connector. Pipe connections over 50mm nominal diameter shall be studded pads suitable to receive flanges to B.S. 4504.

The Tank supports shall be furnished and installed by the Main Contractor.

3.4.2. Water Tanks

Furnish and install Cold Water Storage Tank with capacities as indicated on the Drawings. The Tank shall conform to Bye-Law Number 30 and shall be glass-reinforced plastic, having externally-flanged sides and internally flanged base, as manufactured by Tricel or approved equal. The tank shall be pre-insulated and suitable for indoor/outdoor installation.

Co-ordinate tank support requirements before installation of the mechanical services. Adequate space should be provided for maintenance particularly for inspection of tanks and fittings. A screened overflow pipe should be provided from each tank to the external in a location where any overflow will be noticed by the building users.

Tank shall include but not be limited to:

- Ball Valve and Brackets (By Mechanical Contractor)
- Overflow Connection with screen to prevent ingress of insects etc.
- Mains Water Connection
- Connections for Domestic Systems
- One 900mm x 900 Access Manhole with tight-fitting hinged cover
- Vent with bird-proof screens
- Drain at base of Tank
- Screened air inlet with corrosion resistant mesh (0.65mm maximum opening)
- Internal lining suitable for contact with drinking water

Test:

The Tank shall be tested by filling with water. Any leaks or imperfections shall be corrected by the Contractor by using approved methods. The Contractor shall pay for any water lost by leakage. Tank shall be inspected by the Engineer prior to filling.

Drip Tray:

A drip-tray constructed of 1.2mm galvanised steel shall be erected beneath tank supports. The Tray shall be 150mm deep with rolled top and with double lapped seams at all plate joints. Tray shall extend 150mm beyond tank on all sides.

Drainpipe

A drainpipe shall be carried outside the Building, as shown on the Drawings and shall be complete with all necessary flashing. Drain shall terminate in such a position that any discharge will be immediately detected.

Cold water and mains water break tanks

Cold water and mains water break tanks to comply with;

- BS 8558:2011
- BS EN 806

3.5. WATER METERS

Water meters shall be located with easy access for reading. Each water meter will be of the full flow accumulative type water meter with dial indicator and pulsed output to record quantity of water passed. The body of each water meter will be cast iron and will contain a helical vane mounted centrally in the body of the meter. Each meter shall have a water guide at its inlet, a zeroing device, an interchangeable pattern mechanism and isolating valves at either side of the meter.

If meters have a bore which is smaller than that of the pipe-work it is connected to then flanged reducers are to be installed for connecting the meter to the pipe-work.

3.6. THERMOSTATIC MIXING VALVES.

All thermostatic mixing valves are to be TMV3 approved to NHS Model engineering specifications - D 08.

3.7. HOT WATER GENERATION EQUIPMENT

This specification covers the supply to site and installation of hot water generation equipment.

The following are the principal Standards which shall apply:

- BS 853-1:1996 Specification for Calorifiers for Central Heating and Hot Water Supply
- BS 2871 Specification for Copper and Copper Alloys
- BS 8558:2011
- BS EN 806

Where references are made to Irish or other International Standard Specifications products shall be selected to meet the system operating conditions.

3.7.1. Hot Water Storage Cylinders**Hot water cylinders shall be provided in accordance with:**

- BS 6700.
- BS 720.
- BS 8558:2011
- BS EN 806

Water heaters will be installed with adequate space for maintenance and in accordance with all manufacturers' recommendations. A safety valve is to be installed on all water heaters with linked to tundish drain line to floor or other safe location.

Cylinders shall be fixed to allow for floor finishes. Wall-mounted units shall be securely fixed and vertical. Sufficient clearance shall be maintained to allow withdrawal and replacement of heating elements and anodes. Hand-holes and man-ways shall be located to face the access positions. Pipe connections shall be independently supported and impose no load on the cylinder. Cylinders connected in parallel shall have fully accessible individual isolating valves.

Safety valve discharge pipes shall terminate below floor gulley gratings. Where the termination point is remote, identification labels shall be fitted.

3.7.2. Unvented Hot Water Storage Calorifiers

Cylinders connected in parallel shall have fully accessible individual isolating valves. Unvented hot water storage calorifiers, up to 500 litres capacity and with a heat input not exceeding 45kW, shall be proprietary units certified by the British Board of Agrément, or manufactured to BS EN ISO 8501-1. Unvented hot water storage calorifiers of more than 500 litres capacity, or having a heat input of more than 45kW, shall be to the requirements of BS 6700 and The Building Regulations.

Insulation:

The cylinders shall be completely insulated with a removable casing sealed as a semi-shell, 70mm thick polyurethane all around with an external red PVC finishing.

Test Certificates:

Manufacturer's Hydraulic Test Certificates shall be provided in triplicate.

- Maximum working pressure: primary 8 bar – secondary 8 bar
- Maximum storage temperature 99°

Hot Water Storage Calorifiers

Hot water service storage calorifiers shall be to BS 853-1. Each calorifier shall have a dial thermometer with lagging extension and isolating cock. Sacrificial anodes shall be provided. Dielectric separation shall be provided.

3.8. AVOIDANCE OF STAGNANT WATER IN PRESSURISATION UNIT EXPANSION VESSELS

Pressurisation and expansion units are to be provided on all re-circulating circuits in order mitigate the risk of stagnant water and subsequent bacterial growth.

3.9. TESTING, CLEANING AND COMMISSIONING

3.9.1. Contractor Method statement

At least two months before the start of any testing cleaning or commissioning a method statement shall be provided to the Employer's representative outlining the programme and any details (including chemicals etc.) of testing cleaning and commissioning

3.9.2. Specialist for Cleaning and chemical treatment

For the design, supply, installation and operation of systems used for cleaning or chemically treating the contractor shall use a specialist.

3.9.3. Conditions for cleaning and chemical treatment

All statutory authority and health and safety regulations must be complied with in treatment of systems. Treatment should be co-ordinated with all equipment manufacturers for the installed systems and the need for any further treatments as recommended by manufacturers shall be carried out. Any chemicals used in the treatment of systems must be compatible with all system and equipment materials. Any dangers posed by standard treatments to particular systems or equipment should be highlighted on laminated notices in the boiler-house to avoid future maintenance damaging systems or equipment.

3.9.4. Analysis of Mains water

The contractor is to carry out an analysis of the mains water supply at the site supply point using an independent laboratory. The results are to be evaluated with the local water authority in order to establish that the results are typical for the area. If results are not typical for the area a report is to be provided to the Employer's Representative. Tests are also to be carried out for:

- Total Viable Count
- Pseudomonas
- Sulphate Reducing Bacteria
- Hardness

The water hardness is to be reported to the Employer's representative.

Preliminary checks

The following items are to be addressed before chemical treatment or cleaning is carried out:

Removal of all foreign matter.

For all sections that are to be cleaned, all certified pressure tests with inhibited water have been carried out, the pipe-work has been left full with water and no further tests are to be carried out in this section. (Inhibited mono-ethyleneglycol is used in areas which have a risk of freezing)

All parts of the system have had circulation demonstrated and approved. All valves are left fully open (except for those used to isolate sections for cleaning).

Following flushing, cleaning and passivation the system is to be balanced and certified.

The contractor is to ensure that:

- No damage occurs to any plant or equipment during cleaning or chemical treatment.
- Any chemicals used are compatible with the system materials
- Any equipment which becomes blocked due to cleaning is replaced.
- Solids removal is facilitated by the installation of dirt pockets with drain valves at low points.
- All drainage system pumping equipment is fully commissioned and all drains have been approved and tested.
- Loops are provided at all dead legs greater than 3 pipe diameters to facilitate cleaning.

- Temporary strainers and filters are installed for the cleaning process and all equipment strainers or filters are removed (spools/stools will be installed temporarily if necessary)
- These strainers are clean at cleaning initiation, during the process and upon completion.
- Minimum 50mm drainage and supply points, valved or plugged are provided as necessary.
- All air vents are fully commissioned
- Chemical cleaning and treatment is fully compliant with COSHH regulations.
- Effluent tanks are provided for all waste products of cleaning and chemical treatment processes if required by local water authority.
- Waste products will be neutralized and disposed to drain; or disposed at registered sites subject to local water authority approval.
- Compliance Waste Management Duty of Care: A Code of Practice and Control of Pollution (Special Waste) Regulations

3.9.5. Testing

All water services pipe-work is to be pressure tested as follows:

Water System Testing	
Type to be Tested	Testing Parameters
< 3.5 bar operating gauge pressure	Test at one and a half times operating pressure.
3.5 – 7.0 bar operating gauge pressure	Test at twice operating pressure.
Below ground pipe-work	Test at 7 bar or twice operating pressure, whichever is greater for 4 hours.

A programme of testing times is to be provided to the Employer's Representative and other appropriate personnel at least a month in advance of testing so that tests can be witnessed.

All testing is to be carried out before systems are permanently concealed or buried.

The following guides are to be adhered to in all testing:

- HVCA Guide to Good Practice for Site Pressure Testing of Pipework
- HSE Guidance Note GS4 Safety in Pressure Testing

Prior to the application of insulation each section is to be tested for one hour as work proceeds. A record of all pressure tests shall be kept by the contractor. A copy will be issued to the Employer's representative and another copy will be issued to the client as part of the O&M Manuals.

3.9.6. Commissioning

Commissioning codes

The standards set out in the CIBSE Commissioning Codes are to be met for the installed systems. Commissioning of the installed systems is to be carried out in

accordance with the recommendations of the BSRIA Application Guides for water system and air systems in order to achieve these standards.

Preliminary checks

Commissioning procedures and checks are to be carried out in accordance with CIBSE Commissioning Code W and the BSRIA Application Guide 2/89 'Commissioning of Water Systems in Buildings' pre-commissioning checklist. The system shall be confirmed as being statically complete in accordance with BSRIA Application Guide 2/89 'Commissioning of Water Systems in Buildings'.

Setting to work and regulation

The water distribution systems are to be set to work and regulated in accordance with CIBSE Commissioning Code W and the BSRIA Application Guide 2/89 'Commissioning of Water Systems in Buildings'

Measurement

The measurement instruments to be used are detailed in BSRIA Application Guide 2/89

Outlets shall be tested in groups to confirm that appropriate flow rates and temperatures are achieved.

Record of Performance tests

The contractor is to keep a systematic record of tests. A copy will be issued to the Employer's representative and another copy will be issued to the client as part of the O&M Manuals.

Flushing of System

Ensure that all necessary pipe-work ancillaries are installed in order for flushing, inspection and witnessing of pipe-work systems to be carried out by a contractor's specialist in accordance with BSRIA Application Guide 1/2001.

All water systems are to be flushed in accordance with BSRIA Application Guide 1/2001 'Pre-Commission Cleaning of Pipe-work Systems' and BS:6700 to the satisfaction of the local water supply authority with mains water until the water is clear.

Domestic water systems are to be flushed and disinfected in accordance with BSRIA Application Guide 1/2001 'Pre-Commission Cleaning of Pipe-work Systems' and BS:6700 to the satisfaction of the local water supply authority with mains water until the water is clear. .

Ensure that all water used for testing, flushing and filling is of good quality. Once pressure testing is completed the pipe-work should be left full and treated.

Any temporary connections from the mains are to be in accordance with Water Supply Regulations. Alternatively a tank and pump arrangement can be used.

System Witnessing

A signed confirmation of inspection of the water system and tanks shall be obtained by the contractor from the Employer's Representative following cleaning of the system. The system will be re-cleaned and sterilised if dirt is found to be present at any stage between cleaning and handover.

Chemical cleaning and solids removal

The water systems shall be chemically cleaned in accordance with BSRIA Application Guide

1/2001 'Pre-commission cleaning of pipe-work systems' and BS 6700.

Sterilization

Sterilization
Sterilization – General
Ensure that suitable temporary connections are provided at system terminal points in order that sterilization chemicals and fluids can be introduced. Also ensure that, immediately downstream of the main isolating valve, a 22mm valved drain connection is provided on the incoming main Sterilization of the water systems is to be carried out in compliance with BS 6700. This will take place after each system is flushed, cleaned and drained. The system is then to be filled with clean, fresh water.
Sterilization - Mains Water System
Carry out the following operations in accordance with BS 6700. Flush system and introduce sterilisation chemical. Take samples from all sentinel points to ensure correct chlorine concentration. Leave system to stand for period of time indicated. Repeatedly flush system with clean water until all traces of chlorine have been removed - leave system filled. Submit samples to registered laboratory for microbiological analysis and report. Immediately prior to handover, retake samples and submit for analysis and report.
Sterilization - Water Storage Systems
Carry out the following operations in accordance with BS 6700 and Health and Safety Executive Approved Code of Practice and Guidance - Legionnaires' disease - control of legionella bacteria in water systems. Carry out operations on all water storage tanks and cisterns, cold and hot. Carry out procedures as for mains water systems.
Documentation
Within handover documentation include the following: Certificate confirming that the water systems have been cleaned, sterilised and tested Details of routine cleaning and sterilisation required that will be required by the end user

3.9.7. Water Testing

The contractor will have full water tests to S.I. 278: 2007 carried out by an independent laboratory to ensure that the chemical content and bacterial content of the water are satisfactory. Each test will be carried out on a Monday morning before any use occurs and there has been a minimum standstill period of two days on the water system. One test will be carried out shortly after the works are completed and the other will be carried out 9 months after the installation is complete. All test details and results are to be forwarded to the employer's representative.

The first sample has to be taken at the test point in the boiler house and then the second shall be taken at the final tap on the system. The sample drinking water taken from the system shall be witnessed by the building manager, Care Taker or Consulting Engineer. The samples shall be then brought to an independent lab upon completion to be tested. The test shall comply with all parameters as listed in SI 278 of 2007. It must also take into account the revised maximum acceptable lead level of 10 µg/l (European Drinking Water Directive (DWD 98/83/EG)).

The water hardness is also to be reported to the Employer's representative.

Measures to Prevent Legionnaire's Disease

The following documents relating to prevention of Legionnaires disease will be adhered to in the installation, testing, cleaning and commissioning of all pipe-work and systems:

- All Current CIBSE guidance for prevention of Legionnaire's Disease
- Current Health and Safety Legislation for prevention Legionnaire's Disease
- Any Local Authority Requirements for prevention Legionnaire's Disease

3.9.8. Standards and Regulations

The latest versions (or superseding standards) of the following standards are to be complied with:

Standard	Use For
IS EN 12266 1 & 2	Testing of valves at manufacturers works
IS EN 1213 ASSE 1003 IS EN 13959	Valves
IS 5154 ISO DIS 12149	Globe valves
IS EN 13828	Ball valves
IS 1212 NEP 43 003	Float valves
IS 2456	Plastic floats for float valves
IS 5154 IS EN 12288	Check valves
IS 2879	Drain cocks
BS 21 IS EN 10226-1	Threaded connections
IS EN 1254-3	Compression connections
IS EN 60335-2-41 & IS EN 60335-2-51	Pumps manufacture
IS EN 9906	Pump testing
IS EN 13280	GRP Tanks and their installation

BS 6700	Installation of plastic cisterns
BS 5422 BS 5970 BS 476-4 , 6, 7 BS 3958-5	Pipework thermal insulation
BS 5970 clause 8.2	Insulation adhesives
IS EN 1254-1, 2	Lead free solder for fittings on potable water systems.
IS EN 29454-1	Flux for copper pipework
IS EN 1415-1	Water meters
IS EN 1057	Copper for pipework

4. GAS SUPPLY AND HEAT PRODUCTION – GAS FIRED SYSTEM

4.1. GENERAL

The contractor will contact the gas supply utility and organise, project manager, attend and supervise the provision of natural gas to the site and building(s) including the main gas meter. All pipe-work to the main gas meter shall be provided by the gas utility with all trenching and builder's works provided by the contractor. The contractor shall supply and install a lockable cover for the gas meter which shall be suitably tamper-proof. The contractor shall provide full installation of all gas pipe-work after the meter. This will include to all required boilers and water heaters.

Adequate is to be provided for maintenance of the system and its associated components.

All required supports and plinths are to be co-ordinated and provided.

Boilers and Flues are to be installed in accordance with manufacturer's recommendations. Both boilers and flues are to be supplied, installed (with required supports), tested and commissioned before practical completion with all testing and commissioning certificates provided to the Employer's Representative and also included in the O&M Manuals.

All plant must be stored in a fully weather tight area within the site and should not be brought to site until such an area is made available. Any damage to plant up until handover will not be accepted resulting in replacement of such plant by the contractor at no extra cost to the client. Any scratched or damaged boiler covers will be replaced, plant is not to be used as work surfaces or for standing on. If the area of storage is deemed to not be sealed suitably the Employer's Representative will require a certificate from the contractor confirming there is no damage to plant.

4.1.1. Cleaning of System

Before concealment or handover all services are to be fully cleaned.

4.1.2. Manufacturer's instructions

Storage, preparation and installation of all plant, equipment, fittings and materials will fully comply with manufacturer's recommendations.

4.1.3. Requirements Concealed Gas Pipe-work within the Building

In order to ensure there is no build-up of gas within voids all gas pipe-work installed within voids shall be installed with mild-steel pip-work sleeves which open to the adjacent rooms at either side of the void.

4.2. INSTALLATION AND WORKMANSHIP

4.2.1. Boilers

Supply and install a matched boiler(s) and burner(s). The burner(s) shall be provided with controls fully wired. Each boiler shall be installed with a securely fixed engraved plate detailing the boiler manufacturer, model, date, and duty in kW.

Adequate access shall be provided for maintenance of the installed boilers. Each safety valve will have a piped outlet to the floor or other safe location.

4.2.2. Chimneys and Flues

Supply and install flue systems with confirmed suitability (prior to ordering) for the provided boiler(s) (or other equipment) including all necessary branches, fittings, weather flashings, rain caps and supports. Flue terminations will be in positions and installed in compliance with the current building regulations. In order to maintain an air tight building seal weather flashings are to be installed and fully sealed at flue terminations. No bends greater than 45° are to be installed on the flue system.

4.2.3. Fuel Pipe-work

All external underground gas lines will be supplied and installed in polyethylene pipe having no underground joints.

All internal gas pipe-work will be supplied and installed in medium grade mild steel pipe-work. If below ground joints are unavoidable they will fusion welded and approval must be received from the Employer's representative before installation.

For above ground oil pipe-work all joints and fittings are to be welded except connections for plant, valves and equipment which will be with flanged or screwed connections to allow ease of maintenance. Final connections to boilers and gas heaters will be made with flexible connections.

4.2.4. Support spacing

Gas pipe-work shall be supported as per the following table.

Gas Pipe-Work Support Spacing		
Pipe Bore (mm)	Horizontal (m)	Vertical (m)
Up to 15	1.2	1.8
22	1.4	2.1
28	1.8	2.1
32	2.4	3.0
35	2.4	3.0
42	2.4	3.0
54	2.7	3.0

67	3.0	3.0
Over 67	3.0	3.0

The minimum support distance should be used where supports are used on a length that has multiple diameters.

4.2.5. Fittings

Fabricated fittings are not to be used.

Valves

Valves	
General	
All valves are to be pressure tested at the manufacturer's works.	
All valves shall be kite-mark certified.	
All valves shall be attached to pipework with screwed fittings.	
All valves shall be manufactured from materials that are suitable for and do not degrade in contact with natural gas.	
Stop Valves ≤ 50mm	
Material	Ductile iron body; stainless steel shaft; rubber coated ductile iron disc; EPDM seat.
Construction	Semi-lugged wafer type design, for installation between mechanical joints, body with grooved ends.
Type	Lever operated (gradual notch) butterfly valves. Provide lever and gear operated valves with long body neck for lagging clearance. Seat - Bonded.
Manufacturer	BSS
Stop Valves >65mm	
Material	Cast iron body; stainless steel shaft; aluminium bronze disc; EPDM seat.
Construction	Provide controlled elastomer compression on flange faces; semilugged wafer type design, for installation between flanged pipework connections. Provide lever and gear operated valves with long body neck for lagging clearance. Seat - Bonded.
Type	Lever operated (gradual notch) butterfly valves
Manufacturer	BSS

4.2.6. Water Heater Installation

The water heater shall be installed in full compliance with all manufacturer's instructions and recommendations. Adequate space shall be provided for servicing and maintenance. A safety valve connected to a tundish drain line shall be installed terminating in a safe location.

4.3. TESTING, CLEANING AND COMMISSIONING

Flushing

The pipe-work system shall be purged using compressed air prior to hand-over to ensure it is free from all particles and dirt.

Testing

All gas pipe-work shall be tested using the following guidance:

IGE/UP/1 Soundness testing and purging of industrial and commercial gas installations shall be fully complied with.

All gas pipe-work shall be pressure tested to 3.5bar (test gauge) in accordance with IS EN 12327.

All pipe-work systems are to be pressure tested, before permanent concealment or covering, in accordance with the procedures of HVCA Guide to Good Practice for Site Pressure Testing of Pipe-work and HSE Guidance Note GS4 Safety in Pressure Testing.

The employer's representative shall be notified a minimum of one month in advance of test times so that they can be witnessed.

All equipment and systems which fall under the scope of the Pressure Equipment Directive (PED) 97/23/EC must have CE Marks proving they are certified as compliant with the directive.

Commissioning

Commissioning is to be carried out in accordance with CIBSE Commissioning Code B and Manufacturer's Recommendations for all plant, equipment and systems.

A systematic record of tests is to be kept. Records of both tests/commissioning and proof of calibration of instruments for testing/commissioning are to be provided to the Employer's Representative. This is to include certificates detailing the flue gas analysis and boiler efficiency.

Commissioning boiler plant

The boiler plant is to be fully commissioned in accordance with CIBSE Commissioning Code B and all manufacturers recommendations.

Fully completed boiler commissioning sheets are to be provided to the Employer's Representative outlining clearly each boiler's efficiency and emissions.

4.4. STANDARDS AND REGULATIONS

The latest versions (or superseding standards) of the following standards are to be complied with:

Standard	Use For
IS EN 12266-1, 2	Testing of valves at manufacturers works
ASSE 1003 IS EN 13959	Valves
IS 5154 IS EN 12149	Globe valves
BS 2456	Plastic floats for float valves
IS EN 593	Butterfly valves between mechanical joints
IS EN 1092-1,2,3, 4	Butterfly valves between flanges
BS 21 IS EN 10226-1	Threaded connections
IS EN 1254-3	Compression connections
BS 845 – 1 IS EN 483	Thermal performance of boilers
BS 5978 BS 5986 IS EN 656	Safety of gas fired hot water boilers
BS 6283 IS EN 1490 BS 6759-1 BS 759	Boiler safety devices
BS 759-1 IS EN 303 1 TO 7	Boiler Mountings
BS 6759-1 IS EN ISO 4126	Boiler Safety valves
BS 5885 IS EN 676	Manufacture of gas burners
IS EN 230	Automatic burner controls
BS 5854	Dilution flues (if specified)
BS 6644	Gas fired boiler installation
ASTM UOP 172	Analysis of flue gases
IS EN 1856-1 BS 7566 IS EN 1859	Chimney installation
IS EN 12327	Testing of gas systems
IS EN 12327	Commissioning of gas systems
IS EN 12327	Pressure testing of gas systems

5. AIR SOURCE HEAT PUMPS

5.1. APPLICABLE STANDARDS

- EN 378-1, Refrigerating systems and heat pumps – Safety and environmental requirements – Part 1: Basic requirements, definitions, classification & selection criteria
- EN 12102 Air conditioners, liquid chilling packages, heat pumps and dehumidifiers with electrically driven compressors for space heating and cooling - Measurement of airborne noise - Determination of the sound power level

- EN 12828:2003, Heating systems in buildings – Design for water-based heating systems
- EN 12831, Heating systems in buildings - Method for calculation of the design heat load
- EN 14336, Heating systems in buildings – Installation and commissioning of water based heating systems
- EN 14511 series Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling
- EN 14511-1:2004, Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling – Part 1: Terms and definitions
- EN 14825 Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling – Testing and rating at part load conditions and calculation of seasonal performance
- I.S. EN 15450:2007. Heating systems in buildings - Design of heat pump heating systems
- prEN 15316-4-2, Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-2: Space heating generation systems, heat pump systems

5.2. AIR SOURCE HEAT PUMPS (ASHP) – DESIGN CONSIDERATIONS

The heat pump units shall be:

- Selected to cover 100% of the annual heating energy demand (kWh) of the building
- designed for, and include, fittings for permanent installation.
- designed and controlled so as to avoid excessive start-up cycles (e.g. three start-up cycles per hour).
- The maximum number of start-up cycles per hour (or other time unit) shall comply with any requirements stated by the local utility and shall be in accordance with the heat pump manufacturers technical requirements.
- Designed so as to be user-friendly and require limited maintenance.
- Designed such that the output capacity of the heat pump shall be capable of being matched to the building heat demand.
- Designed such that the minimum air flow declared by the manufacturer, is taken into account when designing the system.
- The air entering the evaporator of the heat pump (outdoor air or exhaust air), shall be clean according to the ASHPs manufacturer's specifications.
- For bivalent systems, a suitable balance point temperature shall be set depending on the selected operational mode (bivalent-alternative or bivalent-parallel mode), as described elsewhere in the specifications.

5.3. CE MARKING & ECOLABELLING

The appointed Contractor shall be responsible for ensuring that the following requirements are met, when selecting ASHPs

5.4. CE MARKING, ECODESIGN AND ENERGY LABEL

All ASHPs and/or components shall be CE marked as required by the applicable EU directive(s) and/or regulations. They shall also comply with the applicable Ecodesign and EU Energy Label Regulations.

5.5. SEAI TRIPLE E REGISTER

ASHPs being proposed shall be included on the SEAI Triple E Register.

Alternatively, technical documentation and diagrams which satisfactorily demonstrate compliance with the requirements for inclusion on the triple E register, shall be provided, where a proposed unit is not listed on the SEAI Triple E Register.

N.B: In offering such a product it shall be the responsibility of the Contractor to satisfactorily demonstrate equivalence.

5.6. WARRANTY & PRODUCT LONGEVITY

The appointed Contractor shall be responsible for ensuring that:

- Repair or replacement of the heat pump and each of its components will be covered by the warranty terms for a minimum of five years from the date of commissioning.
- that genuine or equivalent spare parts will be available for at least ten years from the date of purchase & confirm this stipulation, in writing
- Where repair work is undertaken the maximum time period from notification of the fault through to its resolution must be stated together with the provision which will be made for temporary alternative heat sources where required
- a copy of the warranty terms offered for the product is provided. Where an extended warranty has an additional cost, this shall be clearly indicated within the pricing schedule.

5.7. PERFORMANCE CRITERIA

Minimum & Target Seasonal Performance Factor (SPF) values for ASHP

The appointed Contractor shall be responsible for ensuring that:

- The heat pump system is designed to achieve a high seasonal performance factor (SPF).
- Minimum values for SPF (for space heating and domestic hot water production) as well as target values for SPF for good design practice shall be as per Table C1 of IS EN: 15450-2007
- The selected ASHPs shall meet the performance criteria set out below for:
 - Coefficient of performance (COP) across the range of connected capacities and including 100% (full load) in heating mode
- Product Category: Air to Water. Heating Mode CoP: >4.00

5.8. ASHP OPERATION & ENVIRONMENTAL IMPACT

In proposing ASHPs, the appointed Contractor shall be responsible for ensuring that:

- The environmental impact due to heat pump operation is minimised.
- The selected refrigerant for use with the heat pump shall have an ozone depletion potential (ODP) of Zero (ZDP) and a low global warming potential (GWP) (see also EN 378-1).
- Care shall be taken not to permit the refrigerant to escape into the atmosphere due to leakages during operation, as well as during maintenance.

5.9. ASHP ENERGY EFFICIENCY PERFORMANCE

The appointed Contractor shall be responsible for ensuring that:

- the levels of energy efficiency performance, indicated in its tender are met both at the point of installation/commissioning and during the entire warranty period.

- Where this is dependent upon specific usage instructions and maintenance activities, these must have been clearly highlighted in the tender.
- Regular, ongoing inspections and testing of the equipment to ensure continued compliance, during the warranty period, will be carried out

Where the inspections or tests indicate that the designated levels of energy efficient performance are not being achieved, the appointed Contractor shall be responsible for ensuring that:

- The equipment and or any of its components are repaired and/or replaced, and the costs of any such work carried out will be borne by the Contractor
- The maximum time period for remedying any default in environmental performance shall be 7 working days from the date on which the fault is notified to the Contractor.
- Where required by the contracting authority, the Contractor shall provide suitable alternative heat sources during the repair period.

Noise emission Levels

The ASHPs are to be installed in a noise-sensitive building, i.e. schools, according to the scope of Directive 2002/49/EC relating to the assessment and management of environmental noise.

The appointed Contractor shall be responsible for ensuring that:

- The noise levels do not exceed the maximum thresholds, specified by Planning conditions.
- A declaration together with test results showing the noise emissions (A-weighted sound power level limit value and where applicable C-weighted sound power level limit value) is provided in support of demonstrating compliance with the required maximum noise thresholds.

5.10. INSTALLATION

5.10.1. General

The appointed Contractor shall be responsible for ensuring that:

- The manufacturer's installation instructions shall be adhered to when installing the system.
- suitably qualified and experienced personnel will undertake the installation of the equipment and any ancillary works.
- Fitters and service personnel are fully trained and qualified. Training should comprise the following non exhaustive list of elements:
 - Assembly, installation and commissioning of the specific products covered by the contract
 - Pressure testing of components
 - Electrical testing of equipment
 - Testing controls and meters
 - Ensuring safety devices are correctly installed and working
 - Operational testing of individual components of the system (e.g. boiler, fluid transfer pumps, distribution system)
 - Testing the whole system under a range of normal operating conditions
 - Adjustment of the equipment to energy-efficient settings
 - Air emission measurement techniques
 - Technical and legal documentation for the products (certificate of conformity, commissioning and test reports).

N.B: The installation of all internal and external units, refrigerant pipe work, inter-connecting wiring, testing shall be carried out by the above suitably qualified and experienced i.e., approved Installer.

5.10.2. System Controls

With regard to proposed ASHPs, the appointed Contractor shall be responsible for ensuring that:

- All necessary controls, to allow the building user to:
- Interface with the heating system, regarding the values and timing of the desired indoor temperature, thereby efficiently operate the heating system.
- Interrogate the system to establish relevant data such as actual indoor and/or outdoor temperature(s),
- interface with the wider BMS system
- are supplied &/or installed by the unit manufacturer
- Heat pump systems are equipped with appropriate controls that prevent a major leakage of refrigerant, in case of accident.

5.10.3. Operating instructions and user information

The appointed Contractor shall be responsible for ensuring that:

- In addition to the normal manufacturer's technical manuals and operating instructions, a clear and concise set of operating instructions and user information written in "plain English" shall be provided.
- These Plain English Instructions shall be sufficient to guarantee optimum environmental performance of the ASHPs, is provided to the client.

5.11. MAINTENANCE

The appointed Contractor shall be responsible for ensuring that:

- The proposed ASHPs can be easily dismantled & reassembled by professionally trained personnel using commonly available tools, for the purpose of repairs and replacements of worn-out parts, upgrading older or obsolete parts, and separating parts and materials, ultimately for reuse or recycling.

6. HEATING SYSTEM PIPEWORK

6.1. GENERAL

All heating system pipe-work and fittings as required for the building shall be supplied and installed.

The pipe-work installation is to be completed with connections to all heat emitters and plant.

All heat emitters shall be supplied and installed.

Access will be provided for maintenance. Any required access hatches are to be provided by the main contractor.

All water pipe-work and fittings shall be fully suitable for:

- Low pressure hot water distribution
- Any water treatment chemicals which may be introduced
- Any temperatures which are to be found in the system

6.1.1. Venting of System

A means of venting all pipe-work systems at all high points is to be provided. This will be in the form of automatic air vent valves at all high points except for those agreed with the Employers Representative. Access to all air vents is to be co-ordinated with the main contractor before any work begins.

A means of draining all pipe-work systems at all low points is to be provided. This will be in the form of drain points at all low points except for those agreed with the Employers Representative. Access to all air vents is to be co-ordinated with the main contractor before any work begins.

6.1.2. Isolation and Regulation Valves

Isolation valves are to be supplied and installed in the following locations in grouped, aligned manner with levers facing the user:

- At the base of all main risers and drops except where only one fitting is served
- Before connections to equipment
- At main system branches.

Local positions shall mitigate the risk of tampering.

Access will be provided for maintenance. Any required access hatches are to be provided by the main contractor.

6.1.3. Cleaning of System

All installed pipe-work is to be cleaned and degreased prior to concealment or handover.

6.1.4. Manufacturer's Instructions

Manufacturer's instructions are to be followed for the storage, preparation, and installation of all equipment, fittings, and materials.

6.1.5. Equipment and Space Dimensions

The dimensions of all equipment and emitters shall be checked before ordering. Any co-ordination issues relating to access, space, recesses etc. are to be brought to the attention of the Employer's Representative before ordering or they will be replaced at no additional cost to the client.

6.1.6. Installation Programme

All plant must be stored in a fully weather tight area within the site and should not be brought to site until such an area is made available. Any damage to plant up until handover will not be accepted resulting in replacement of such plant by the contractor at no extra cost to the client.

No low level pipe-work is to be installed in a room until that room is fully weather tight.

6.2. INSTALLATION AND WORKMANSHIP

6.2.1. Pipe-work

Medium grade black mild steel pipework is to be supplied and installed for all internal water services unless other materials are specifically requested on the drawings.

6.2.2. Insulation for Pipe-work and fittings

A specialist contractor shall be used for the supply and installation of insulation. All insulation shall be manufactured in compliance with the latest version (or superseding standards) of IS EN 9000-2. All insulation is to be installed in a neat manner and be undamaged at handover.

Insulation is to be provided on all pipe-work, valves and joints.

Valves with a diameter of less than 65mm will be insulated in the same manner as pipe-work. For easier maintenance valves in excess of 65mm will have insulated jackets with Velcro seals.

All pipe-work insulation is to be foil-faced mineral wool as follows.

Maximum thermal conductivity: 0.038 W/moC (at a mean temperature of 500oC).
Density: 80-120kg/m3.

Any insulated pipe-work outside of the plant-room which is exposed is to be installed with minimum 0.56mm thickness profiled aluminium cladding protection with reinforcement bands at 300mm intervals. All cladding is to be undamaged at hand-over.

The extent of exposed insulated pipe-work is to be fully determined and allowed for at tendering stage. Where a contractor is unsure if pipe-work is exposed or not clarification shall be sought at tender stage as no additional costs will be accepted due to misinterpretation of the documents.

Mineral wool insulation thickness shall be as follows:

Mineral Wool Insulation Thickness			
Pipe Size (mm)	LPHW Pipework (mm)	External Pipework (mm)	Pipe Size (mm)
15	30	50	15
20	30	50	20
25	35	50	25
32	35	50	32
40	40	50	40
50	40	50	50
65	40	50	65

80	40	50	80
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6.2.3. Protection of External Pipework

Polyisobutylene (PIB) protection is to be provided on all external pipe-work. The following installation guidance shall be adhered to:

Minimum 0.8mm thickness PIB sheeting is to be used to wrap (lapping by a minimum of 50mm at all joints) all pipe-work and fittings. Joints are to be installed so as to prevent the ingress of water, they are to be solvent welded and support with banding as per manufacturer's instructions.



Exposed external valves are to be installed with valve jackets. Any external above – ground pipe-work is to be installed with trace heating with control panels and all other necessary equipment to prevent freezing.

6.2.4. Maintaining Integrity of Vapour Barriers

Any and all vapour barriers must have their integrity maintained. Any damage to such vapour barriers shall be repaired as per manufacturer's instructions. The maximum permeance value for vapour barriers shall be 0.05g/sMN.

6.2.5. Insulation Materials

All building services insulation materials are to be CFC and HCFC free (zero ozone depletion potential) and must maintain their thermal performance for a minimum of twenty five years.

Insulation is to be kept dry at all times and surfaces are to be fully dry before installation of insulation.

Urethane foams, Extruded polystyrene, Polyisocyanurate foam and Polyethylene foam are not to be used.

Pipe-work installed together must not be insulated in one enclosure, each pipe is to be insulated separately in a neat manner with all joints and corners uniform and all overlaps even, parallel and arranged to fall on the back of the pipe where possible. .

Joints are to be close butted together and secured with adhesive or matching class 'O' tape (> 50mm wide) on all overlap edges in all directions.

Fittings are to be insulated to the same standard (with the same taping arrangements) as connecting pipe-work.

Where a vapour seal or fibre containment is necessary a taped seal should be provided between the exposed insulation membrane and the pipe surface.

Class 'O' foil tape shall be used where pipe support inserts that have integral vapour barriers abut insulation in order to maintain the integrity of the vapour barrier or containment

Phenolic foam pipe supports shall be used where insulation runs through pipe supports. Ensure that the integrity of vapour barriers is maintained.

All valves, flanges and other fittings on insulated pipe-work are to have equivalent vapour barrier and insulation performance to pipe-work.

6.2.6. Fire Protection

All insulation shall be compliant with Euroclass A1 and will have a maximum smoke obscuration rating of 5% tested in accordance with the latest version (or superseding standard) of IS EN ISO 5659-2.

When the installation is complete it shall have a surface finish that meets the requirements of the latest version (or superseding standard) of BS476-7 Class 1 (spread of flame).

6.2.7. Thermal insulation of plant

For insulation of plant such as pumps and other non-uniform shapes the insulation must be demountable where maintenance access is required and should be submitted for approval to the Employer's Representative in adequate time before installation.

6.2.8. Electrical Bonding for Pipe-work

In order that pipe-work is properly earth bonded electric bonding terminals are to be provided where required for connection of 6mm² conductors.

6.2.9. Pipe-work Joints

All pipe-work joints are to be welded. Screwed joints are to be used for connections to all valves and equipment for easy maintenance. All welding is to be carried out by a skilled craftsman with a current certificate of competence from an approved authority appropriate to type and class of work. Certificates for all welders should be provided to the Employer's Representative on request.

Pipe-Work Joints		
Type	Preparation	Installation

Oxy-acetylene welding	As per BS 1821 or BS 2640	Installation in compliance with BS 1821 or BS 2640 appropriate to system temperature and pressure. Use oxy-acetylene welding process on piping less than 100mm diameter.
Arc welding	As per BS 2633 or BS 2971	Installation in compliance with BS 2633 or BS 2971 appropriate to system temperature and pressure. Use arc welding process on piping greater than 100mm diameter.
Screwed Joints	Ensure that plain ends are cut square. Reamer out bore at plain ends. Screw plain ends, taper thread.	Coat male pipe threads with jointing compound and hemp, or PTFE tape on small sizes. Immediately after applying coating, connect with female end of socket or fitting, and tighten ensuring that coating does not intrude into pipe. Leave joint clean.

6.3. EXPANSION DEVICES

For each straight length of pipe-work exceeding 25metres an expansion device shall be installed. Expansion loops should be used wherever there is adequate space however where there is not an expansion bellows should be used.

6.3.1. Expansion Loops

Expansion loops sized to limit stress in the material of the pipe wall to 69MPa are to be provided in the same material as the general pipe-work.

A single length of pipe should be used to form the expansion loop, alternatively if the loop is too large to be formed from one length it can be formed through welding.

6.3.2. Expansion compensators

Expansion compensators are to be axial bellow type with flanged ends. The expansion bellow is to be manufactured from stainless steel. The expansion bellows must be capable of withstanding, without deforming, a pressure test of 1.5 times the design pressure. Each bellows must also be capable of a minimum of 2000 complete reversals of movement at the working conditions.

6.4. SPACING OF PIPE-WORK SUPPORTS

Medium grade black mild steel pipe-work shall be supported as per the following table:

Steel Pipe Supports		
Pipe Bore (mm)	Horizontal (m)	Vertical (m)
Up to 15	1.8	2.4
20	2.4	3.0
25	2.4	3.0
32	2.7	3.0
40	3.0	3.6
50	3.0	3.6
65	2.7	3.0
80	3.7	4.6
100	3.7	4.6
125	3.7	5.4
150	4.5	5.4

Where multiple pipe runs of differing bores are supported from a common point, use support spacing of pipe requiring closest spacing.

6.4.1. Anchors

Anchors shall be designed to resist all axial stresses resulting from flexure of pipe-work and constructed in materials matching or compatible with the supported pipe-work. The design of all anchors shall presume unbalanced forces exist at the anchor point.

Ensure that the structure is capable for transmitted stress. Provide and fix all associated backing plates, nuts, washers and bolts for attachment to or building into building structure. Anchors are to be properly lined up and grouted.

Provide anchors constructed using mild steel overstraps or heavy U-bolts. Secure to channel section, adequately attached to or grouted into building structure; weld longitudinal edges of strap to pipe.

6.5. INSTALLING FLEXIBLE CONNECTIONS

Flexible connections are to be installed to vibrating plant in accordance with manufacturer's recommendations. Where flexible connections are installed to vibrating equipment fit rubber bellows as close to the source of vibration as practicable with the other end being a fixed point. If plant is mounted on vibration isolating mountings then the flexible connection is to be tied. .

Terminal Unit Connections

Install hose connections strictly in accordance with manufacturer's instructions.

6.6. FITTINGS

Fittings – Installation

Headers	
Terminate ends with blank, bolted flanges.	
Screwed Flanges	
General	Apply jointing materials. Screw on flange and expand tube into flange with roller expander where necessary.
Preparation	Ensure that flange mating faces are parallel; flange peripheries are flush with each other; and bolt holes are correctly aligned.
Installation	Insert jointing between flange mating faces. Pull up joint equally all round.
Flexible Couplings And Flange Adapters	
Preparation	Ensure that cut ends are square and free of bumps, dents and score marks and are within manufacturer's tolerances.
Installation	Ensure gasket is suitable for service. Thoroughly lubricate gasket using manufacturer's recommended lubricant. Assemble coupling in accordance with manufacturer's instructions. For non-end load capable couplings, ensure that adequate pipe anchorage is provided to prevent pipe disengagement.

6.7. VALVES

Valves	
General	
All valves are to be pressure tested at the manufacturer's works.	
All valves shall be kitemark certified.	
All valves shall be attached to pipework with screwed fittings.	
All valves shall be manufactured from a copper alloy.	
Stop Valves	
To be provided:	For isolation of pipe-work up to 67mm Diameter
Type:	Lever Operated with Anti-blowout stem.
Manufacturer:	BS BOSS Fig 966S, brass full bore ball valve, WRC approved

Materials	Bronze or DZR copper alloy body Chrome or nickel plated DZR sphere with full bore flow aperture PTFE seals and stem seals
Ends:	Threaded
Stop Valves	
To be provided:	For isolation of pipe-work up over 67mm Diameter
Type:	Lever (with graduated notch plate) operated with Anti-blowout stem. Provide controlled elastomer compression on flange faces; semi lugged wafer type design, for installation between flanged pipework connections, body to suit IS EN 1092-2. Provide lever and gear operated valves with long body neck for lagging clearance. Seat - Bonded.
Materials	Cast iron body; stainless steel shaft; aluminium bronze disc; EPDM seat.
Regulating Valves	
Type:	Screwed regulating valves up to 65Dia. Flanged for 65 Dia and above. M733 DRPN16 Or equivalent and approved. WRAS approved.
Manufacturer	Up to 50 mm NHN Ltd. Fig. 1432, Fig. 1473. Over 50mm HNH Ltd. Fig.
Materials	To suit steel tube
Double Regulating Valves	
Type:	Screwed double regulating valves up to 65Dia. Flanged for 65 Dia and above. WRAS approved. Provide drain plug facility; independent means for positive isolation on pressure tapping or adapter.
Manufacturer:	HNH Ltd. Fig. CV 2432. Fig CV 2373 (low flow)
Materials	Cast iron to IS EN 13789. Oblique or Y pattern; copper alloy, nickel alloy or resilient valve face; rising stem outside screw or non-rising stem inside screw; manufacturer's standard materials.
Radiator Valves	
Type:	Pattern - Angle or straight to suit application. If Straight - Threaded to BS 21 or compression to IS EN 1254-2 (BS 864-2) to suit pipework as

	indicated. If Angle - Threaded to BS 21 with one end internal and other end external with union nut and tail pipe; or compression joint to IS EN 1254-2(BS 864-2) one end and other end externally threaded to BS 21 with union nut and tail pipe to suit pipework as indicated. Fit wheel valves on flow connections to radiators, and other heat emitters, without thermostatic radiator valves. Fit lockshield valves on return connections.
Materials	Bronze or brass copper alloy body.
Ball Valves:	
Type:	Valve - Two way control valve. Rotary Actuator - Modulating. Lever for manual operation.
Materials	Nickel-plated brass; stainless steel ball; PTFE seal; stainless steel spindle; EPDM spindle seal.
Ends:	Threaded to BS 21
Three Way Valves:	
Type:	Three way control valve. Rotary Actuator – Modulating. Lever for manual operation.
Manufacturer:	
Materials	Nickel-plated brass; stainless steel ball; PTFE seal; stainless steel spindle; EPDM spindle seal.
Ends:	Threaded to BS 21.
Check Valves:	
Type:	Swing check, screwed. WRAS approved.
Manufacturer:	HNH
Materials	Pipe material - to suit steel tube.
Ends:	Screwed Connection
Direct Acting Safety Valves	

Type:	Double spring loaded, high lift type. PN rating 10.
Manufacturer:	NVEIG Ltd. NABIC Fig. 42 (screwed / flanged)
Materials	Up to and including 65 Dia.: Bronze or DZR copper alloy body. Over 65 Dia.: Cast iron body.
Requirements:	Confirm all safety valves are set to appropriate pressures. Provide test Certificates for all safety valves prior to practical completion.
Ends	Up to and including 65 Dia.: Threaded Over 65 Dia.: Flanged.

6.8. OTHER ANCILLARY ITEMS

Other Ancillary Items	
Test Plugs	
To be Provided:	As required for measurement of temperature and pressure allowing the system to be fully commissioned
Type:	Provide DZR copper alloy self-sealing test plugs for measurement of temperature and pressure, complete with captive cap for sealing when not in use. Ensure test plugs are suitable for system operating temperature and pressure.
Manufacturer:	Mechseal or approved equivalent
Pipe Strainers	
Type:	Screwed up to 50mm, flanged for 65mm and above. Y pattern body. Screen free area - Not less than 250% of pipe bore. Provide plugged connections for drain, air vent and differential pressure monitoring, threaded to BS 21. Internal to external flow through screen.
Manufacturer:	Up to 50mm HNH Ltd. Fig. 87 65 and above: HNH Ltd. Fig 810 PN16
Materials	Bronze to IS EN 1982. up to 50mm Cast iron 65mm and above
Screen Perforations:	15 to 50mm nominal size, within range 0.7 - 0.9 mm diameter. 65mm and over nominal size, within range 1.5 - 1.8mm diameter.
Ends	Threaded to BS 21 up to 50mm and flanged to IS EN 10982 for 65mm and over.
Gauges	
To be Provided:	On common flow and return header to boilers.

	- On main variable temperature flow and return connections. - In additional locations as indicated on the drawings.
Type:	Use dial type gauges of robust construction, enclosed in dust tight metal cases. Retain dial glass with bezels screwed to case. Finish with chromium plating. Use white dial scales indelibly and clearly marked with black lettering to indicate measured values. Select scale ranges which indicate 'Normal' when pointer is vertical or central on scale. Dial case - 100mm diameter for flush mounting to steel panel. Mount gauges with dial face in vertical plane flush to panel and conceal casing within a steel metal cubicle.
Manufacturer:	BSS Ltd.
Drain Cocks	
To be Provided:	Fit at all low points in the system that cannot be drained through outlets.
Type:	Lock shield connection to accept key, fit outlet with hosepipe connector.
Manufacturer:	HNH Ref 371
Ends:	Threaded
Automatic Air Vents	
Type:	Ball float. Provide automatic air release mechanism. Maximum temperature, 110oC. Maximum pressure 10 bar.
Manufacturer:	Chas. Winn Ltd. type B
Construction:	Vertical steel housing with internal large surface area mechanism to remove microbubbles via coalescence effect. Fitted with dirt drain at its lowest point for removing dirt that sinks, and fitted with a dirt drain valve on the side of the housing for removing dirt that floats on the water.
Ends	Line size with flange

6.8.1. Air Separators

Air Separators shall be Flamco Flexcon Type 'S', complete with Flexcent Auto Vent and shut-off valve, installed as per Manufacturer' instructions

6.9. PUMPS

General

All pumps must be of type and material suitable for both the fluid conditions and the pump application. For the required duty of the system pumps are to be selected at or near the most efficient part of their performance curve.

Pumps are to be installed, in a manner where they are supported separately to the pipe-work, in accordance with all manufacturer's recommendations (including the position and orientation of the pump). Adequate access is to be provided for maintenance.

6.9.1. Circulation Pumps

Pump capacity, head, motor electrical rating and other pertinent data shall be as indicated in schedule. Motors shall be suitable for non-overloading operation regardless of pumping rate. Pumps in parallel shall be guaranteed by the pump manufacturer to parallel each other. Pumps shall be designed to exhibit a continuously rising head, characteristic from maximum capacity to shut-off. Pump Curves shall be forwarded to the Consulting Engineer and approved prior to being included in Tender.

6.9.2. Heating Circulating Pumps

Circulating Pumps shall be of the variable speed type equipped with enclosed type impeller, stainless steel shaft, and mechanical type shaft seal. Suction and discharge shall be flanged.

Pumps shall be manufactured to B.S. 1394 and shall be CE Certified by Grundfos or equal.

6.9.3. Pump Electrics

Motors which have star connections or have stardelta starting to limit peak voltage to 1200 volts are to be provided with manufacturer fitted supply surge arrestors. Also to be manufacturer fitted are supply transient suppressors in the form of resistor and capacitor networks across the starter contactor coils.

Motors are to be fully compliant with BS 2048-1, BS 4999, BS 5000: Index, IS EN 50347 and IS EN 60034, as applicable. Motors are to operate at their lowest possible speed while still compatible with performance requirements.

The maximum continuous rating of motors should be selected so that the motor temperature remains within the limits outlined in IS EN 60034-1 and that the motor runs at the desired speed(s) when operating at design duty.

Ensure that protection devices operate within the tripping tolerances outlined in IS EN 60947-4.

Class 130 or 155 insulation is to be used.

Ensure temperature rise of motors is to be in compliance with IS EN 62114.

Motors are to be fitted with cable glands or cable entry terminal boxes (to suit supply cable size and type)

All motors are to be class EFF1 high efficiency motors as per the EU/CEMEP scheme for the designation of energy efficiency classes for motors.

The following table shows the outline necessary efficiency requirements for various motors:

Power	Min EFF Class 1 (%)	
kW	2 Pole	4 Pole
1.1	82.2	83.8
1.5	84.1	85.0
2.2	85.6	86.4
3.0	86.7	87.4

Positive temperature co-efficient (PTC) thermistors in compliance with BS 4999-111 are to be used to provide over-temperature protection to all motors. A minimum of 3 positive temperature co-efficient (PTC) thermistors are to be provided for each motor. Two permanently marked ends are to be terminated in the motor terminal box.

6.9.4. Motor Starters

Motor Starters
Motors Greater or Equal to 0.37kW
Provide starters incorporating overcurrent protection for motors of 0.37kW and above. Provide starter with manual reset, adjustable, inverse time delay, and ambient temperature compensated thermal overcurrent release to IS EN 60947-4-1. Ensure overcurrent release is compatible with starting, accelerating and running characteristics of motor, starter and driven machine combination. Use phase unbalance protection on three phase equipment.
Current Limiting Motor Starters
Use static type thyristor voltage control starter to provide reduced current starting. Provide adjustable ramp times. Provide contactor for switching and disconnect for isolation. Provide details of harmonic distortion content prior to ordering.
Direct-On-Line Motor Starters:
Use direct-on-line starter to IS EN 60947-4-1, with single phase motors and three phase motors.

Star Delta Motor Starters

Use star delta starter to IS EN 60947-4-1 with three phase motors. Incorporate adjustable time delay contactor relays, to control star delta changeover, ensuring electrical endurance compatible with starter contactors. Ensure starting sequence activated on voltage restoration.

Auto-Transformer Motor Starters

Use auto-transformer starter to IS EN 60947-4-1 with three phase motors.
Provide 2 step closed transition auto transformers suitable for 3 operating cycles per hour.
Provide auto transformers with three tappings for selection of motor starting voltage.
Arrange tappings to limit motor starting current to 80 per cent, 65 per cent and 50 per cent of full voltage starting current.
Incorporate adjustable time delay contactor relays, to control automatic changeover from selected reduced voltage to full voltage, having an electrical endurance compatible with starter contactors. Ensure starting sequence activated on voltage restoration.

Stator Rotor Motor Starters:

Use stator rotor starter to IS EN 60947-4-1 with three phase motors.
Provide starter resistors suitable for indicated operating cycles per hour.
Incorporate adjustable time delay contactor relays, to control starter resistor short circuiting contactors, having electrical endurance compatible with starter contactors.
Ensure starting sequence activated on voltage restoration.

6.9.5. Pump Access

Adequate access will be provided for all pumps and will be in compliance with all manufacturer recommendations.

6.9.6. Location of valves

Valves for motors are to be provided in compliance with manufacturers recommendations. A double regulating valve should be installed for each pump with equivalent straight pipe before and after the valve as follows:

- Upstream: 10 diameters
- Downstream: 5 Diameters

Control components should be installed with adequate access for maintenance and operation and they shall also be supported so that no strain acts upon the component.

Discharge pipes should be provided for all vent cocks.

6.9.7. Vibration isolation mountings

Excessive noise and vibration shall be prevented by the installation of vibration isolating mountings to all equipment which is recommended to have vibration control by manufacturers or may negatively impact upon the required acoustic environment of adjacent/nearby spaces.

6.9.8. Pressure equipment regulations:

All equipment and systems which fall under the scope of the Pressure Equipment Directive (PED) 97/23/EC must have CE Marks proving they are certified as compliant with the directive.

6.9.9. Installation of heat emitters

Radiators shall be to BS EN 442-1 to -3. Radiators shall be fabricated from mild steel. For special applications cast iron or aluminium may be used. Aluminium radiators shall only be used where appropriate specialised water treatment is provided.

Steel radiators shall be of steel sheet welded at the seams, strengthened by spot welding between waterways, be free from distortion, have pressings which are regular in shape, and be uniform in appearance.

Cast iron radiators shall be free from scale and sand before fitting.

Aluminium alloy radiators shall be of die cast manufacture of material to BS EN 1559-1 & -4, BS EN 1706 and BS EN 1676. Connections to copper pipe shall be made with iron nipples. The manufacturers' recommendations for water treatment shall be strictly adhered to.

Spacing above the floor and away from walls shall ensure that specified output is achieved. Wall-mounted radiators shall be fixed 50mm minimum from the supporting wall and 100mm minimum above finished floor level

Each radiator shall have a recessed vent plug, wheel valve on flow and key operated lock-shield valve on return connections. Valves shall be 'easy clean' type with union connection, straight or angle pattern to suit piping arrangements.

All heat emitters are to be installed in compliance with manufacturer's instructions. Radiators shall be installed level and at common heights in an aesthetically pleasing manner. Radiators are to be securely fixed with any proposed floor-based or non-standard supports presented in a site mock-up for Employer's Representative approval before installation. Radiators are to be fully co-ordinated in terms of recesses (where required) and supports.

6.10. TESTING, CLEANING AND COMMISSIONING

6.10.1. Method statement

At least two months before the start of any testing cleaning or commissioning a method statement shall be provided to the Employer's representative outlining the programme and any details (including chemicals etc.) of testing cleaning and commissioning

6.10.2. Specialist for Cleaning and chemical treatment

For the design, supply, installation and operation of systems used for cleaning or chemically treating the contractor shall use a specialist.

6.10.3. Cleaning and chemical treatment conditions:

All statutory authority and health and safety regulations must be complied with in treatment of systems. Treatment should be co-ordinated with all equipment manufacturers for the installed systems and the need for any further treatments as recommended by manufacturers shall be carried out. Any chemicals used in the treatment of systems must be compatible with all system and equipment materials. Any dangers posed by standard treatments to particular systems or equipment should be highlighted on laminated notices in the boiler-house to avoid future maintenance damaging systems or equipment.

6.10.4. Preliminary checks

The following items are to be addressed before chemical treatment or cleaning is carried out:

Removal of all foreign matter.

For all sections that are to be cleaned, all certified pressure tests with inhibited water have been carried out, the pipe-work has been left full with water and no further tests are to be carried out in this section. (Inhibited mono-ethyleneglycol is used in areas which have a risk of freezing)

All parts of the system have had circulation demonstrated and approved. All valves are left fully open (except for those used to isolate sections for cleaning).

Following flushing, cleaning and passivation the system is to be balanced and certified.

The contractor is to ensure that:

- No damage occurs to any plant or equipment during cleaning or chemical treatment.
- Any chemicals used are compatible with the system materials
- Any equipment which becomes blocked due to cleaning is replaced.
- Solids removal is facilitated by the installation of dirt pockets with drain valves at low points.
- All drainage system pumping equipment is fully commissioned and all drains have been approved and tested.
- Loops are provided at all dead legs greater than 3 pipe diameters to facilitate cleaning.
- Temporary strainers and filters are installed for the cleaning process and all equipment strainers or filters are removed (spools/stools will be installed temporarily if necessary)
- These strainers are clean at cleaning initiation, during the process and upon completion.
- Minimum 50mm drainage and supply points, valved or plugged are provided as necessary.

- All air vents are fully commissioned
- Chemical cleaning and treatment is fully compliant with COSHH regulations.
- Effluent tanks are provided for all waste products of cleaning and chemical treatment processes if required by local water authority.
- Waste products will be neutralized and disposed to drain; or disposed at registered sites subject to local water authority approval.
- Compliance Waste Management Duty of Care: A Code of Practice and Control of Pollution (Special Waste) Regulations

6.10.5. Testing

All water services pipe-work is to be pressure tested as follows:

Water System Testing	
Type to be Tested	Testing Parameters
< 3.5 bar operating gauge pressure	Test at one and a half times operating pressure.
3.5 – 7.0 bar operating gauge pressure	Test at twice operating pressure.
Below ground pipe-work	Test at 7 bar or twice operating pressure, whichever is greater for 4 hours.

A programme of testing times is to be provided to the Employer's Representative and other appropriate personnel at least a month in advance of testing so that tests can be witnessed.

All testing is to be carried out before systems are permanently concealed or buried.

The following guides are to be adhered to in all testing:

- HVCA Guide to Good Practice for Site Pressure Testing of Pipework
- HSE Guidance Note GS4 Safety in Pressure Testing

Prior to the application of insulation each section is to be tested for one hour as work proceeds. A record of all pressure tests shall be kept by the contractor. A copy will be issued to the Employer's representative and another copy will be issued to the client as part of the O&M Manuals.

6.10.6. Commissioning

Commissioning codes

The standards set out in the CIBSE Commissioning Codes are to be met for the installed systems. Commissioning of the installed systems is to be carried out in accordance with the recommendations of the BSRIA Application Guides for water system and air systems in order to achieve these standards.

Preliminary checks

Commissioning procedures and checks are to be carried out in accordance with CIBSE Commissioning Code W and the BSRIA Application Guide 2/89 'Commissioning of Water Systems in Buildings' pre-commissioning checklist. The system shall be

confirmed as being statically complete in accordance with BSRIA Application Guide 2/89 'Commissioning of Water Systems in Buildings'.

Setting to work and regulation

The water distribution systems are to be set to work and regulated in accordance with CIBSE Commissioning Code W and the BSRIA Application Guide 2/89 'Commissioning of Water Systems in Buildings'

Measurement

The measurement instruments to be used are detailed in BSRIA Application Guide 2/89. Outlets shall be tested in groups to confirm that appropriate flow rates and temperatures are achieved.

Recording of Performance tests

The contractor is to keep a systematic record of tests. A copy will be issued to the Employer's representative and another copy will be issued to the client as part of the O&M Manuals.

Flushing

Ensure that all necessary pipe-work ancillaries are installed in order for flushing, inspection and witnessing of pipe-work systems to be carried out by a contractor's specialist in accordance with BSRIA Application Guide 1/2001.

All water systems are to be flushed in accordance with BSRIA Application Guide 1/2001 'Pre-Commission Cleaning of Pipe-work Systems' until the water is clear.

Ensure that all water used for testing, flushing and filling is of good quality. Once pressure testing is completed the pipe-work should be left full and treated.

Any temporary connections from the mains are to be in accordance with Water Supply Regulations. Alternatively a tank and pump arrangement can be used.

Witnessing

A signed confirmation of inspection of the water system and tanks shall be obtained by the contractor from the Employer's Representative following cleaning of the system. The system will be re-cleaned and sterilised if dirt is found to be present at any stage between cleaning and handover.

Chemical cleaning

Carry out chemical cleaning procedure in accordance with BSRIA Application Guide 1/2001 Pre-commission cleaning of pipework systems.

Sterilization

Ensure that suitable temporary connections are provided at system terminal points in order that sterilization chemicals and fluids can be introduced. Also ensure that, immediately downstream of the main isolating valve, a 22mm valved drain connection is provided on the incoming main

Sterilization of the water systems is to be carried out in compliance with BS 6700. This will take place after each system is flushed, cleaned and drained. The system is then to be filled with clean, fresh water.

LPHW System Chemical dosing

Biocides are to be provided as recommended by a contractor-engaged water treatment Specialist to be effective against Legionella Pneumophila, algae, fungi, moulds and slime forming bacteria including pseudomonas and sulphate reducing bacteria.

Where required, as recommended by the water treatment specialist, a bio dispersant should be provided in order to remove slime masses.

The water treatment specialist will also select and provide:

- Appropriate corrosion inhibitors (to minimise corrosion, with particular care for any aluminium present in the system)
- Biocides (to prevent any proliferation to mild steel, copper and copper alloys)
- Cleaning agent

Documentation:

As part of the O&M Manuals at handover stage the contractor will provide certification confirming the system has been cleaned, sterilised and tested. The contractor will also provide easy to follow methodologies for routine maintenance requirements.

The following will also be provided:

- Programme outlines.
- Purpose of chemical treatment.
- Chemicals used and quantity.
- On site testing procedures.
- Control limits of tests.
- Equipment data and drawings.
- Product notes and material safety data sheets for all chemicals used.

Chemical provision:

One year of chemical supplies for routine maintenance shall be provided.

System Balancing:

All systems are to be fully balanced using the procedures outlined in BSRIA and CIBSE Commissioning Guides. The contractor is to keep a systematic record of commissioning point flow-rates. A copy and proof of calibration of instruments for balancing will be issued to the Employer's representative prior to hand-over for comment.

Thermostats and temperature sensors

Calibration equipment certified as being calibrated within six months of testing will be used to test all thermostats and temperature sensors

Performance testing

The system shall be tested under a full range of conditions. The following operations are to be checked before arranging Employer's Representative witnessing of correct operation of system:

- Operation of run and standby plant
- All control settings
- All control systems functions

Venting of heat emitters

Vent all air from heat emitters prior to testing, and again at practical completion.

6.11. STANDARDS AND REGULATIONS

The latest versions (or superseding standards) of the following standards are to be complied with:

Standard	Use For
IS EN 10255	Steel pipework
IS 21:1985	Steel fittings - Screwed
BS EN 10255-1, PN 16	Pipe flanges
IS EN 1092-1	Pipe flanges
BS 7786	PTFE tape
IS EN 751-2	Pipe jointing materials
BS 21	Screwed joints with PTFE tape
BS 1453	Welding rods gas welding
BS 2633 BS 2971	Electric arc welding
BS 2640 BS 2971 HVACA Code of Practice TR/5	Welding of steel pipework
IS EN 12266	Testing of valves at manufacturers works
IS EN 61800-5-1	Variable speed drives on pumps
IS EN 13828	Ball valves
IS EN 593	Butterfly valves
BS 7350	Globe valves
BS 2767	Radiator valves
IS EN 215	Thermostatic radiator valves
BS 5154	Check Valves
IS EN 442	Radiator manufacture

7. VENTILATION

7.1. GENERAL

All ventilation services (ductwork, terminals, and plant) as required for the building shall be supplied and installed.

The installation is to be completed with connections to all terminals and louvres.

Access will be provided for maintenance. Any required access hatches are to be provided by the main contractor.

7.1.1. Cleaning

All installed ventilation ductwork and systems are to be clinically cleaned in compliance with HTMs, HVCA document DW/TM2 prior to concealment or handover.

7.1.2. Weatherproofing

The contractor shall supply and install all required weatherproof seals. Where ductwork passes through/terminates at the roof the ductwork shall be fitted with trimming angle

and weather cravat, skirt, flashing plate and cowl to form a weatherproof seal to the structure.

7.1.3. Sleeves

Purpose made sleeves made from the same material as the duct will be used to sleeve any ducts which pass through building constructions e.g. walls, floors, partitions etc. Each sleeve is to be filled tightly with a non-flammable and fire resistant material such as mineral fibre in order to form a fire/smoke stop of the same rating as the fire barrier. This filling will also prevent air movement and noise transmission between duct and sleeve

7.1.4. Manufacturer's instructions

Manufacturer's instructions are to be followed for the storage, preparation, and installation of all equipment, fittings, and materials.

7.1.5. Equipment and Space Dimensions

All equipment must have adequate maintenance access, any issues in relation to the maintenance access for any equipment must be notified in writing to the Employer's representative before ordering or they will be replaced at no additional cost to the client.

7.2. SPECIFICATION FOR MECHANICAL VENTILATION WITH HEAT RECOVERY (MVHR)

7.2.1. Scope

The scope of ducted Mechanical ventilation with Heat Recovery (MVHR) Unit/Systems shall consist of the supply & installation of integrated units comprising:

- intake and exhaust fans,
- a counterflow heat exchanger,
- air filters,
- isolating and bypass dampers,
- temperature sensors and a control system.
- Duct system including air diffusion and weather louvres/grilles.

7.2.2. Applicable Standards

EN 16798-3:2017 "Energy performance of buildings - Ventilation for buildings – Part 3: For non-residential buildings – Performance requirements for ventilation and room-conditioning systems

7.2.3. Performance Requirements

The design and installation of the MVHR systems shall not compromise the ventilation, air quality, humidity (and the potential for condensation) and quality of the teaching environment

Noise

- SPL noise emission by MVHR Units shall be limited to 35 dB(A) @ 1 m at 100% capacity and 30 dB(A) @ 1 m at 80% capacity.
- The MVHR Units shall attenuate incoming external noise by at least 48 dB before entering the room.

Air Filtration

- Air filters shall be provided on both the intake and extract air pathways.
- Filters shall conform to at least ISO 16890 ePM10 75%. Indication shall be provided of filter maintenance being due. For polluted environments, intake filters shall conform to ISO 16890 ePM1 55%.

Building Regulations Compliance

The selected MVHR units shall comply with the relevant Parts of the building regulation, as follows:

- Building Regulations (Part B): The system must be suitable for incorporation into structures such that it does not compromise the ability of the building to resist internal fire spread within the structure and external fire spread. Matters to be taken into account inter alia, will include:
 - suitable detailing of components passing through other elements of the building
 - the location and type of fire-stops to be used
 - the method of providing air transfer
 - the integrity of protected stairs and halls
 - the integrity of walls and floors.
 - Building Regulations (Part C): When installed as per the system supplier's guidelines, the system should not affect the property's ability to resist weather and ground moisture.
 - Building Regulations (Part D): When installed as per the system supplier's guidelines, the system shall meet the Building Regulations requirements for materials and workmanship.
- Building Regulations (Part F): The MVHR units shall be suitable for use in a non-domestic building and meet the ventilation requirements.
- Building Regulations (Part L): The ventilation system shall conserve energy in compliance with the Building Regulations

7.2.4. CE Marking & Ecolabelling

The appointed Contractor shall be responsible for ensuring that the following requirements are met, when selecting MVHR units:

CE marking, Ecodesign and Energy Label

- All MVHR units and/or components shall be CE marked as required by the applicable EU directive(s) and/or regulations. They shall also comply with the applicable Ecodesign and EU Energy Label Regulations.

SEAI Triple E Register

- MVHR units being proposed shall be included on the SEAI Triple E Register.
- Alternatively, technical documentation and diagrams which satisfactorily demonstrate compliance with the requirements for inclusion on the triple E register, shall be provided, where a proposed unit is not listed on the SEAI Triple E Register.
- N.B: In offering such a product it shall be the responsibility of the Contractor to satisfactorily demonstrate equivalence.

7.2.5. MVHR Unit - Description

Each MVHR unit shall comprise as a minimum:

- Integrated high efficiency counter flow heat exchanger with a minimum efficiency of not less than 80% at design volume and be compliant with the requirements of the Energy related Products (ErP) Directive 2018.
- Low noise fans in accordance with the noise level stated elsewhere within the specification.
- Each MVHR Unit shall have a Specific Fan Power (SFP) of not > 1.2 W / l / sec.
- The SFP value shall take account of fans, electronic controls and all actuators.
- G4 grade high efficiency filters on both supply and extract sides.
- Summer bypass facility.
- Manual setting or on/off control of the bypass is not permitted.
- The unit shall have appropriate means of control, as described elsewhere in this section
- EC fans with infinitely variable min / max speed settings and backward curved impellers
- Fans shall be capable of providing a constant air volume regardless of filter clogging or duct/system pressure drops (within the fans operation limits).
 - Fully insulated construction with integral acoustic barrier mat and double skinned wall construction.
 - Condensate drip tray and connection to drain via dry trap
 - Automatic frost protection
 - All associated control and power wiring.
 - Access to all serviceable parts
 - Provide access panels to maintain the unit in areas which contain a plasterboard ceiling.

7.2.6. Airflow

Systems should be designed to ensure:

- Duty: 10L/s per person
- even distribution of airflow, taking into account the resistance of any ductwork, including bends and fittings.
- It has suitable capacity to meet the performance requirements of the design, taking into account the airflow resistance of the system
- Draught-free operation with an external temperature of -5°C and a room temperature of 21 °C to be proven using Computational Fluid Dynamics (CFD)
 - If this is done using template CFDs, the template configuration shall be reasonably representative of the room under analysis.

The airflow resistance of external terminals shall be calculated in accordance with EN 13141-2.

7.2.7. Indicators, Controls, Monitoring

Indicators

MVHR units shall include visual indicators for maintenance, servicing and operation mode, and these should be visible and not obscured from view.

Controls

Each MVHR shall be provided with a local controller which shall interface with the BMS. Control devices shall clearly indicate the mode the MVHR unit is in (e.g. fan speed, boost, summer bypass, frost protection) and be simple to use.

Each MVHR shall be enabled by a time clock function (which shall be adjustable via the BMS) and controlled via the BMS or via CO2 sensors, which shall allow the unit to

ramp down in periods of low occupancy – please refer to Site Specific Specification for the control mode to be implemented.

Monitoring

It shall be possible to monitor each MVHR Unit via the internet, using either a PC, laptop or mobile. Individual MVHR Units interface modules shall be accessible from local ethernet ports. Where Units have been grouped for control purposes, ethernet access will be required next to the master Units only.

Using online/remote access, the operator shall be able to check up remotely on MVHR Unit performance, carry out fault-finding, resolve potential issues and adjust set points as necessary.

7.2.8. MVHR Systems - Design

Compatibility

The MVHR system shall be designed:

- as a complete package, taking into account the performance of all components and material to ensure they are each full compatible with each other, and that they meet the requirements of the design intent
- including the route of any ductwork, to take account of other building elements,
- not to adversely affect the structural integrity or fire performance of the building.

Variation from the design

The Contractor is free to adopt an alternative solution. However, in such a scenario, the Contractor shall confirm in writing that any proposed variations from the outline design will maintain satisfactory performance of the overall system & daylighting.

The detailed design and specification shall be available on site.

Location of the MVHR unit

- MVHR Units shall be fully concealed and installed within the ceiling void, unless otherwise indicated.
- The MVHR unit shall be located to ensure satisfactory performance and appropriate access for safe maintenance

Fixing of MVHR units

MVHR units shall be fixed to parts of the building capable of taking their load.

Where MVHR units are supported by other elements of the building, the design of the other elements of the building, shall take account of the additional loads.

Where MVHR fan units are supported by framed structures, additional components may be required to provide a secure fixing.

Electrical service

The electrical service to MVHR units shall incorporate a switched fused spur that allows the unit to be isolated.

Noise

MVHR units shall be sized to run at their optimum speed to provide suitable performance whilst taking account of the impact of noise on the classroom environment.

All MVHR's shall be provided with attenuators designed to meet the noise criteria listed in the DoE-TGDs

Type and position of internal air inlets & Outlets

The type of air inlets & outlets shall be selected for its location and function. The MVHR system design shall ensure that air inlet & outlets are appropriately specified for:

- wall/ceiling location
- supply or extract function.
- Both the fresh air intake and exhaust air pathways shall be provided with motorized isolating dampers, arranged to close when the MVHR Unit is out of service, or on activation by fire alarm.

Position of external terminal air inlets & outlets.

To prevent cross-contamination, intake terminals shall normally be separated from exhaust terminals and other potential sources of pollution by a minimum of 1m measured on plan. Increased separation distances may be required between the intake and any:

- soil and vent pipe terminal
- boiler flue outlet
- chimney terminal.

Condensation Control

Any condensate that forms within the MVHR system shall be drained to a suitable outfall.

The MVHR unit shall have an integral condensate management system, incorporating a float alarm to warn of condensate build-up. The alarm signal shall also be used to simultaneously reduce the flow of fresh air and increase exhaust flow, thereby further promoting the evaporation of condensate.

Ductwork Design

Ductwork materials, construction and installation shall comply with the relevant parts of the following publications:

- HVCA DW/144 Specification for sheet metal ductwork - low, medium and high pressure/velocity systems.
- HVCA DW/143 A practical guide to ductwork leakage testing.
- HVCA TR/17 Guide to good practice, cleanliness of ventilation systems.
- HVCA DW/TM2 Internal cleanliness of new ductwork installations.

7.2.9. Installation**Installers**

- MVHR systems shall be installed by operatives who:
- are familiar with the type of system being installed
- can demonstrate that they have a suitable level of knowledge for installing non-domestic MVHR systems.
 - Installation operatives should have successfully completed an appropriate training course such as that offered by the unit manufacturer, or other acceptable course.

Installation- Generally

The MVHR systems shall be:

- installed in accordance with the Contractors approved design.
- securely installed in a neat and workmanlike manner.
- be located, orientated and fixed in accordance with the Contractors design, using the clips, brackets and fixings recommended by the MVHR unit manufacturer.

- Installed such that it is not be in direct contact with other surfaces, such as plasterboard ceilings, that may transfer noise to the room

7.2.10. Commissioning & Balancing of MVHR Systems

MVHR systems shall be:

- commissioned to ensure performance is in accordance with the Contractors approved design
- Air inlet & outlets shall be set in position after the system has been correctly balanced and commissioned, to prevent tampering.
- A commissioning certificate for each MVHR unit shall be provided, and included in the hand over documentation pack.

7.2.11. Operating Instructions and User Guidance

The appointed Contractor shall be responsible for ensuring that, in addition to the normal manufacturer's technical manuals and operating instructions, a clear and concise set of operating instructions and user information written in "plain English" shall be provided.

The pack of plain English information provided to the end user shall be in a format intended for a non-technical user and include:

- user instructions for the MVHR system and its controls
- a description of the system, including the location of components, and an easy-to-follow description of how it works
- details of the necessary routine maintenance to be expected, e.g. changing/cleaning the filters
- the method of cleaning the ductwork (where required)
- guidance for the use of summer bypass and boost settings (where installed)
- contact details of the manufacturer or distributor
- details of the installed system, including part numbers for consumables
- details of any maintenance and servicing agreements.
- the commissioning certificate(s) for each MVHR unit/System

7.3. DUCTWORK

7.3.1. General

Fabricate Ductwork in a workmanlike manner, with airtight joints, smooth surface inside and neatly finished on outside of sizes, runs and connections of ducts as indicated on drawings.

Construct ducts with curves and bends to aid an easy flow of air. Unless otherwise indicated, make centre line radius of curves and bends not less than 1-1/2 times diameter or width of ducts. Where square elbows have to be used, construct such elbows with inside curve of maximum radius permitted by conditions and provide fixed deflectors.

Construct, support and brace ducts and plenum in manner that they will not sag nor vibrate when fans are operating at maximum speed and capacity. All Ductwork that

pierces walls shall be sealed between ductwork and walls with fireproof material equal in fire retardation to the construction through which it passes.

Contractor shall install ductwork in adherence to ceiling height schedules indicated on general construction drawings. Consult with other trades and in conjunction with them, establish necessary space requirements for each trade, so as to maintain required headroom and to avoid interference with other work.

All ductwork sizes on drawings are internal dimensions.

All galvanized steel ductwork and fittings as required for the building shall be supplied and installed to the standards and dimensions outlined in DW144. This will be carried out by a contractor-employed member of the HVCA specialising in the trade of manufacturing and installing ductwork

The installed ductwork is to be of Pressure Classification Class A. The contractor is to provide ductwork leakage test certificates to the Employer's Representative for all installed ductwork to show it meets the required classification.

All air terminals will have flexible ducts (maximum length 0.8m) for final connections.

All fans and air handling units will have flexible joints for connections. These flexible joints will run level to ductwork and will not be used to realign differences greater 25mm. Ductwork should be installed in a manner that allows moisture to drain and does not allow moisture loss at joints (joints must be lapped correctly). No sharp edges or corners are to be present on ductwork, flanges or supports.

For Rectangular duct longitudinal standing seams, use Pittsburg locks on one or more corners, or grooved seam in flat side or sides, depending on the size of sheets available for size of duct. Manufacturer's stamp and gauge designation shall be visible after forming.

All Rectangular ductwork shall be constructed in accordance with the minimum steel thickness as designated in the HVCA DW 144 and shall have all sides cross-broken or beaded to provide panel stiffening.

For Round Ducts, use grooved longitudinal seams, or machine formed spiral wound ductwork for reference to sheet gauge for round ductwork refer to HVCA DW 144.

7.3.2. Elbows and Fittings

Elbows and Fittings shall be shown on drawings, and construction as specified for straight ducts. Round elbows shall be beaded on the downstream end. All square 90 degree elbows shall be fitted with fixed deflecting vanes.

7.3.3. Ductwork Material

Ductwork shall be constructed of steel sheets hot-dipped galvanised to B.S. 2989, Grade Z2 Coating Type 'C'. Fasteners such as sheet metal screws or rivets shall be cadmium-plated. 10.5 Low-Velocity Ductwork Construction and Installation

7.3.4. Flexible Duct Connectors

Provide Flexible Duct Connectors between ducts and fans and ventilation units, also in ducts crossing building expansion joints. Connectors shall be 200mm maximum

length made from a proprietary material to maintain the integrity of the ductwork system to which it is connected with airtight seams. Fasten with bolted galvanised metal bands.

7.3.5. Access Doors

Ductwork: Provide rigid framed access doors in ductwork in locations and of sizes which shall afford easy access to fan bearings, multi-blade dampers, fire dampers and filters. Access doors to be complete with air tight gasket covers designed for easy removal and refitting. Hardware for doors should be heavy-duty type construction with the minimum number of quick release fastening devices suitable for the load shall be used.

7.3.6. Flexible Ductwork

Metal Flexible Duct made of coated steel, stainless steel or aluminium helically wound with a lock seam to form a corrugated duct capable of being bent without deforming the circular section. Bending shall be done by closing the corrugations in the throat and slightly opening the corrugations at the back of the bend. The ducts shall be mechanically fastened at each end and particular care shall be taken to ensure that the required air-tightness of the system is maintained, as indicated in HVCA DW/144. Fastenings should be as for rigid circular ducts.

Flexible Ducts shall be fastened at each end using a propriety band. Care shall be taken not to damage the flexible duct and to ensure that the required air-tightness of the system is maintained. Bending of flexible ducting is not acceptable. Flexible ducts shall be supported in such a way that excessive sagging and consequently kinking of the duct is avoided. The length of flexible ducts shall be as per BSRIA guidelines.

7.3.7. Fabric Flexible ducts

Fabric Flexible ducts shall be manufactured from P.V.C./Polyester laminate or Aluminium/ Polyester laminate encapsulating high tensile steel wire helix. The length of flexible duct used shall be kept to a minimum, consistent with the particular application.

7.3.8. Vibration

The design and installation of the building services systems shall ensure that sufficient vibration isolation is provided that vibration from building services plant and equipment is attenuated and not transmitted into the structure. HVAC plant and equipment shall be provided with sufficient anti-vibration mounting devices to prevent transmission of vibration into the building services distribution pipe work and ductwork.

7.3.9. Fitting of Sensors and Test Holes

Provide test holes in ductwork system to allow complete testing and balancing of system in accordance with CIBSE Commissioning Code Series A. Site drill test holes on site in accordance with DW144 Part 7 Section 20.6. Provide holes in metal ductwork, in accordance with DW144 Part 7, paragraph 20.7, to accommodate sensors. Fill holes that are used only for test purposes with rubber sealing caps.

7.3.10. Balancing of the System

Employ a commissioning contractor to balance air systems in accordance with CIBSE Commissioning Code A, Section A2.

Provide written commissioning reports to the consultant engineer, demonstrating the air flow rates achieved in comparison to the design flow rates.

Carry out commissioning of installations in accordance with the procedures, checks and tolerances given in the BSRIA Application Guide for air systems to achieve the standards set in the CIBSE Commissioning Codes.

7.3.11. Access for Ductwork

Access Panels, with hand operated screw fixings and to the same standards as the ducts in which they are installed, are to be provided at the following positions:

- Beside all fire dampers
- At all fans
- For ductwork inspection and cleaning every 3m

7.3.12. Supports for Ductwork

Ductwork is to be supported tight to the slab. Drop rods shall be cut to within 20mm of the drop rod nuts. Any visibly exposed supports should be fitted plastic end caps. Ductwork supports shall include hardwood inserts of similar thickness to the insulation to maintain a continuous vapour barrier.

7.3.13. Wire Netting

Install wire netting outside vapour barrier as an additional retainer for the insulation in the false ceiling, Plant Room and where ductwork is concealed. Install 18 gauge aluminium cladding outside the vapour barrier as an additional retainer, with all joints beaded weatherproof with a minimum lap of 50mm and arranged to shed water.

7.3.14. Bird mesh screens

A wire bird mesh (minimum gauge < 1mm) shall be installed on all inlet and outlet louvers to the external. The mesh shall be 13mm square pattern.

7.4. INSULATION OF DUCTWORK

Insulation shall be applied by experienced Duct coverers, as per best trade practice and manufacturer's printed installation directions. Insulation shall not be applied before surfaces are cleaned and systems tested. All insulation and finishes shall be Class 'O' fire-rated.

The entire installation shall be strictly in accordance with B.S. 5422: 1977; B.S. 5970: 1992; B.S. 3958 ~ Parts 3 and 4, and B.S. 476 ~ Parts 4, 6 and 7

All supply and return air ductwork shall be insulated with 25mm thick flexible fibreglass duct insulation, density of 45 kg/m cubed, faced with glass-reinforced aluminium foil/paper laminate, Fibreglass Limited or Rockwool flexible duct insulation or equivalent.

The insulation shall be bonded to the ducting with fire-resistant adhesive applied in accordance with the Manufacturer's recommendations. All joints shall be close-butt and sealed with 100mm wide plastic-coated self-adhesive tape. All unavoidable penetrations of the foil vapour barrier and termination of the insulation shall be sealed.

7.4.1. Sound Reduction Insulation

Provide sound lining on interior surfaces of ductwork where indicated on drawings. Sound absorbing material shall be 25mm thick material of fine glass-fibre with dimensionally stable erosion-free sound absorbing woven glass cloth face, Fibreglass Limited SONIC LINER or approved equal. Liner shall be secured to duct by means of an adhesive recommended by the manufacturer, further secured with mechanical anchors adhered to duct on not less than 450mm centres.

All projecting ends of anchors shall be cut off virtually flush. Before installing liner, all edges shall be coated with adhesive where insulation butts together. Overlap of transverse joints shall be secured by metal strips fixed at 75mm centres. Duct sizes shown on Drawings indicate actual nett inside dimensions. Sheet metal sized shall be increased by 50mm in each dimension (width and depth).

7.4.2. Plenums

Furnish and install sound reduction insulation on interior surface of air intake plenums for Air Handling Units and where indicated. Sound absorbing material shall be 25mm thick semi-rigid insulation, weight not less than 48 kg/m cubed, have fire-resistant coating on air stream side, a flame spread rating of 25 max and a smoke developed rating of 50 max. Material shall be Isophon 703 or approved equal. Liner shall be adhered to all surfaces (coated side faces air stream) with fire-resistant insulation bonding adhesive. Further secure the liner with mechanical fasteners on 450mm centres. All projecting ends of anchors shall be cut-off virtually flush. Point all joints with a fire-resistant breaker mastic

All plenums to diffusers to be insulated at a minimum to the same level as ductwork.

7.5. FANS

This Specification covers the Supply, Manufacture, testing in manufacturer's work, delivery to site and commissioning of Extract Fans to supply the Building.

Fans shall be fabricated from zinc electro-plated steel sheet with rigid pressed formed side plates. Impellers shall be forward curved, multi-vane type, dynamically balanced to ensure quiet vibration-free operation.

7.5.1. Extract Fans

Furnish and install twin extract fans to provide continuous extract ventilation, employing the use of twin separate centrifugal fans, each rated for the selected duty so that either can act as a complete standby. Fans and motors shall be resiliently-mounted and fitted with aluminium non-return flaps on each fan outlet to prevent wind blow-back or suction leakage through the idle fan.

Exhaust Fans shall be Flaktwoods, Lindab, Vent Axia, Fantech or approved equal, with accessories as scheduled or approved equal.

For the required duty of the system fans are to be selected at the most efficient part of their performance curve. All fans are to be installed with back draught dampers.

Fans are to be installed, in a manner where they are supported separately to the duct-work, in accordance with all manufacturer's recommendations (including the position and orientation of the fan).

All fans must meet the following minimum efficiencies:

- Forward Curved: 65%
- Backward Curved: 75%

7.5.2. Starter Panels

Provide wall mounting starter panels which provide indication and automatic change-over to the standby fan in the event of the duty fan failing.

7.5.3. Unit Casings

Unit Casings shall be fabricated from aluminium alloy, of folded, riveted and spot-welded construction. Fan chambers shall be lined with 25mm neoprene-faced fibre-glass to reduce resonance and sound levels to a minimum. Access panels shall be provided on both sides of the fan compartment complete with quick-release fastenings. The unit shall be weatherproof, suitable for mounting externally.

Fan Requirements	
Centrifugal Fans	
Installation	Fit safety guards on air inlet and air outlet connections where these are freely accessible to personnel in accordance with BS 848-5. Fit 20mm drain connection at lowest point of scroll. Fit air-tight access doors in scroll and cover.
Electrical Supply	To BS 7697
Electrical Safety	To IS EN 60335-2-80
Materials	Construct casing entirely rigid and free from drumming under operating conditions
Testing	Where fans approved under CAME scheme are used provide certified data for type. Where fans are not approved under CAME scheme provide results of aerodynamic performance tests in accordance with BS 848-1 noise tests in accordance with BS 848-2 and fan vibration tests in accordance with BS ISO 1184695.
Axial Fans:	

Installation	Fit air-tight inspection doors giving access to drive motors and other components requiring regular servicing or maintenance. Fit safety guards on air inlet and air outlet connections where these are freely accessible to personnel in accordance with BS 848-5. Attenuators: The Fans shall be complete with either roof-mounted Q.T. Curbs or duct-mounted attenuators, which shall be selected to attenuate the systems to achieve a maximum noise level of NR40 in the occupied space. Noise levels to atmosphere shall be as specified in the General Technical Specification.
Electrical Supply	To BS 7697
Electrical Safety	To IS EN 60335-2-80.
Materials	Construct casing entirely rigid and free from drumming under operating conditions.
Testing	Where fans approved under CAME scheme are used provide certified data for type. Where fans are not approved under CAME scheme provide results of aerodynamic performance tests in accordance with BS 848-1; noise tests in accordance with BS 848-2 and fan vibration tests in accordance with BS ISO 14695.
Roof Extract Units:	
Installation	Provide sound power data in accordance with BS 848-2. Fit safety guards on air inlet and air outlet connections where these are freely accessible to personnel in accordance with BS 848-5. Fit shutters to prevent reverse flow through fan. Provide access via removable panel. Attenuators: The Fans shall be complete with either roof-mounted Q.T. Curbs or duct-mounted attenuators, which shall be selected to attenuate the systems to achieve a maximum noise level of NR40 in the occupied space. Noise levels to atmosphere shall be as specified in the General Technical Specification.
Electrical Supply	To BS 7697
Electrical Safety	To IS EN 60335-2-80
Testing	Where fans approved under CAME scheme are used provide certified data for type. Where fans are not approved under CAME scheme provide results of aerodynamic performance tests in accordance with BS 848-1 noise tests in accordance with BS 848-2 and fan vibration tests in accordance with BS ISO 14695.
Toilet Extract Unit:	

Installation	Access - provide access via removable panel. Provide auto changeover unit with fan. Provide Back-draught dampers with fan. Attenuators: The Fans shall be complete with either roof-mounted Q.T. Curbs or duct-mounted attenuators, which shall be selected to attenuate the systems to achieve a maximum noise level of NR40 in the occupied space. Noise levels to atmosphere shall be as specified in the General Technical Specification.
Electrical Supply	To BS 7697
Electrical Safety	To IS EN 60335-2-80
Testing	Where fans approved under CAME scheme are used provide certified data for type. Where fans are not approved under CAME scheme provide results of aerodynamic performance tests in accordance with BS 848-1; noise tests in accordance with BS 848-2 and fan vibration tests in accordance with BS ISO 14695.

7.5.4. Attenuators

Attenuators shall have casing constructed to DW 144 and shall have a Class 'O' surface rating. Ensure all adhesives, insulating materials and coverings are non-flammable and non-combustible, complying with BS 476-7, Class 1 in relation to flame spread. Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic.

The Fans shall be complete with either roof-mounted Q.T. Curbs or duct-mounted attenuators, which shall be selected to attenuate the systems to achieve a maximum noise level of NR40 in the occupied space. Noise levels to atmosphere shall be as specified in the General Technical Specification and not to exceed 55 dBA at 1 metre.

7.6. SPECIFICATION FOR GRILLES

7.6.1. General

General: Furnish and install grilles and ceiling diffusers of sizes and in locations included on drawings and as detailed in the equipment schedules and/or specified. Grilles and Diffusers shall be as manufactured by Gilberts or approved equal. All Air terminals devices shall have concealed fixings unless otherwise specified. Blades and dampers shall have finish to match the finish of the air terminal border. All viewable components through the air terminals shall be matt black finish. Floor terminals outlets shall be mounted flush to the final finished surface.

7.6.2. Supply and Extract Diffusers

Supply and Extract Diffusers shall be manufactured from extruded aluminium, with removable cores, adjustable pattern with volume control which can be adjusted by external means. All grilles shall be finished painted with a baked enamel finish and the colour is to be advised at construction stage.

All supply and extract diffusers shall be supplied complete with diffuser box and opposed blade dampers which shall be manufactured and supplied by the diffuser manufacturer.

7.6.3. Ceiling Grilles

Ceiling Grilles shall be provided as scheduled or indicated on the drawings. Grilles shall be made from extruded aluminium sections with mitred corners fully welded and finished complete with an integral volume regulation device which will allow adjustment of the air volume through the front of the grille. Grilles shall be complete with diffuser box which shall be manufactured and supplied by the Grille Manufacturer.

7.6.4. Eggcrate grilles

Eggcrate grilles shall be manufactured from extruded aluminium, with removable cores, adjustable pattern, and rectangular type with volume control which can be adjusted by external means. Grilles shall be complete with diffuser box which shall be manufactured and supplied by the Grille Manufacturer.

7.7. DAMPERS AND OTHER AIR DISTRIBUTION DEVICES

All dampers are to have air-tight seals with total closed position damper leakage of maximum $5\text{m}^3/\text{m}^2/\text{hr}$ at a pressure of 50P. All dampers shall have twin wall blades with opposed blade operation.

7.7.1. Regulators:

Furnish and install splitters, dampers and deflecting vanes, for control of air volume and direction and for balancing system, where shown on drawings, specified or directed.

7.7.2. Turning Vanes:

Where fixed deflecting vanes are shown on Drawings, provide shop fabricated blades. Fit into side strips and screw or rivet to duct elbow in field as per Manufacturer's Printed Installation Instructions. Turning valves, splitters/branches shall installed in accordance with DW 144.

7.7.3. Dampers:

Dampers or splitters shall be of same material as duct, in no case lighter than 20 Gauge. Reinforce as may be required to prevent noise or vibration. Dampers shall have in accessible location, a quadrant with locking device for adjusting and locking damper into position. Stiffen duct at damper location. Install damper in manner to prevent vibration. All dampers shall be installed in accordance with DW/144.

Dampers in the Plant Room shall be of the low-loss type, constructed from aluminium extrusion. Frame and blades to be provided with synthetic sealing strips to reduce air leakage to 2.0% maximum. Bearings and blades shall be low-friction type and double-sealed to prevent dust clogging.

Automatic control dampers shall be fitted with a galvanised mild steel mounting plate rigidly fixed to the casing to support the actuator. Linkages shall be sufficiently robust

to transmit motion to all blades simultaneously. Leakage from spindle penetrations shall be prevented by side seals.

Damper casings shall be of galvanised mild steel sheet 2.0mm minimum thickness, of length to extend beyond the blade swing, and formed into a channel section to provide a rigid assembly. Formed flanges shall be drilled to match adjacent connecting flanges and extend to protect the external blade linkage system. Drilled holes shall be edge-painted with zinc paint immediately after cutting.

Dampers shall be installed in permanently accessible positions. Balancing dampers shall be fitted in each branch from a main or sub-main duct and elsewhere as specified. The required distance from the branch piece shall be maintained. Cross Section Area of dampers shall have 100% free area. Dampers shall be as manufactured by Liberty Air Technology or approved equal.

7.8. FIRE DAMPERS

At all points where a duct passes through a fire wall or other fire barrier an intumescent fire damper is to be supplied and installed in accordance with manufacturer's recommendations. All fire dampers are to be securely mounted within the building fabric.

7.8.1. Fire Dampers (Manual and Motorised)

- All fire dampers shall be EIS 120 supplied by Entropic Limited or equal and approved.
- As required by European and Irish Law through the Construction Products Regulation (EU) No 305/2011, all manual and motorised fire dampers placed on the market on or after 1st July 2013 must be CE marked. A copy of the EC Certificate of Conformity or the Declaration of Performance (DoP) as per EN 15650: 2010 must be submitted to the engineer for inspection and approval prior to purchase.
- All fire dampers must have achieved a fire resistance of EI 120 (Ve-Ho) S when tested in accordance with EN 1366-2:1999 by a New Approach Notified and Designated Organisation (NANDO).
- In all instances, the declared fire resistance of the fire dampers shall be determined using the classification system described in EN 15301-3:2005 in combination with the results of testing to EN 1366-2:1999 by a New Approach Notified and Designated Organisation (NANDO). No other test method (e.g. BS 476 20-24:1987, UL 555, ISO 10294-1:1996) will be acceptable.
- Fire dampers to be installed in walls must carry the letters "Ve" as part of their classification, while dampers for installation in floors/ceilings must carry the letters "Ho".
- All fire dampers must carry the classification "i <-> o" to indicate fire testing from both inside and outside.
- The fire damper casing must comply with the tightness requirements for EN 1751:1999 class C.
- The fire resistance of all dampers must match or exceed the minimum requirements set out in Technical Guidance Document B, Building Regulations of Ireland (2006). The fire dampers shall match the fire resistance in minutes of the separating element in which they are to be installed in terms of integrity (E) and insulation (I).

- The fire damper shall include an external position indicator to enable external inspection of the blade position. It must be possible to trigger the blade release and reset it to the open position without access to the inside of the duct, to enable testing in accordance with BS 9999.
- A copy of the test certificate and physical samples of the product must be submitted to the engineer for inspection and approval.
- Dampers shall be ready for installation as delivered with no additional frames required. The dampers shall be fixed to the fire separating element using a built-in installation flange as per method tested to EN 1366-2.
- In order to facilitate efficient installation, only one damper installation detail is acceptable for concrete walls, lightweight walls, ceilings and floors. Dampers requiring different construction details for installation in concrete walls or stud partitions are not acceptable.
- Dampers shall be manufactured in accordance with the ISO 9001 quality standard and the operations of the manufacturer shall be subject to external third party quality control.
- Each damper shall be accompanied by an installation certificate which must be completed by the installer when the damper is installed and fire-stopped. A copy of this certificate for each damper must be included in the safety file for the project.
- Motors, where applicable, must be fire rated Belimo BF24 T HL and BLF24 T HL as appropriate. Standard non-fire rated motors will not be acceptable. The operating voltage of the motors will be AC/DC 24V. Each motor shall contain two limit switches. For manual testing purposes, fire dampers shall be released and triggered externally.
- The motorised fire damper (fire/smoke damper) control system must be a single-cable system provided by the same supplier as the motorised fire dampers.

7.8.2. Motorised Fire Damper Control System

- The motorised fire damper (fire/smoke damper) control system must be a single-cable system provided by the same supplier as the motorised fire dampers.
- The damper control system field bus cable must be a single cable with minimum 3 cores. The one cable must carry both 24V power and communications to each damper actuator. Systems that require separate cables for power and communication will not be accepted. Systems that require a separate mains power supply at each damper. The system must use an open wiring topology.
- The system must be able to operate an unlimited number of dampers and accept an unlimited number of inputs. The system must be capable of being reprogrammed to any strategy. The number of zones shall be unlimited and easily changed and reprogrammed after installation if required. The system must be easily expandable without changing or upgrading the existing installation.
- The controls devices should be factory fitted to the 24V damper actuators, labeled, programmed and tested prior to dispatch from the factory and delivery to site. 100VA 24V AC transformers are required every 100m of cable or every 10 dampers. Transformers are to be supplied and installed by the electrical contractor.
- As this is a life-critical system, it must be stand-alone and must not run on a Windows-based computer. The system shall allow open communications over various communication protocols to monitoring computers.
- The system shall be capable of connection to the BMS and fire alarm system. The system shall be tested at intervals to be agreed with the fire officer and the end user. The results of each test shall be sent to the BMS and logged by the BMS for future reference.

- Testing and commissioning shall include functional testing of every damper and all cause and effect strategies on the control system. The cause and effects will be witnessed by the engineer. Completion and commissioning certificates must be issued by the supplier of the controls system.

7.9. TESTING, CLEANING AND COMMISSIONING

7.9.1. Sensors and associated test holes

The system shall be tested and balanced in accordance with CIBSE Commissioning Code Series A. To facilitate this test holes are to be provided by drilling in accordance with DW144 Part 7 Section 20.6 and DW144 Part 7, paragraph 20.7 (for sensors). Any holes drilled for testing are to be filled with rubber sealing caps.

7.9.2. Balancing of the system

The system will be commissioned by a contractor–employed commissioning specialist in accordance BSRIA Application Guide for air systems to achieve the standards outlined in CIBSE Commissioning Codes.

The Employer's Representative is to be provided with a clear systematic record of all measured balanced air flow rates and the corresponding design flow rates.

7.9.3. Identification

Bands shall be provided on each duct in each ductwork compartment clearly outlining the purpose of the duct and the air-flow direction within the duct.

7.9.4. Plant Items

Identification labels are to be supplied and installed for all plant and equipment. The labels will be engraved laminated plastic with the name of the equipment, its reference number, its duty and the area it serves.

Identification labels shall be fixed to plant with screws or pop rivets where possible as opposed to being glued.

7.9.5. Charts for System Identification:

A referenced schematic diagram showing all equipment and schedules is to be provided for each system and shall be secured in frames with perspex sheet glazing in the plant or tank room.

7.9.6. Danger and Warning Notices:

Any hazardous system should be colour coded and labelled in accordance with the Health and Safety Executive Guidance Notes.

7.10. STANDARDS AND REGULATIONS

Ductwork materials and construction shall be in accordance with the following Heating and Ventilating Contractors' Association (HVCA) documentation:

The latest versions (or superseding standards) of the following standards are to be complied with:

Standard	Use For
DW/143	A Practical Guide to Ductwork Leakage Testing
DW 144	Ductwork, fitting, fan, and terminal installation
DW 144	Ductwork dimensions
DW 144	Details of connections to plant
DW 144	Leakage testing of ductwork
DW 144 part 2 paragraph 7	Ductwork materials
DW 144 Part 7 section 27	Protective finishes
DW 144 Part 3	Rectangular Ductwork
DW 144 Part 4	Circular ductwork – spirally wound
DW 144 Part 7 Section 7	Flexible ducts
DW 144 Part 7 Section 26	Flexible Joints
DW 144 Part 7 Section 20. Part 7 paragraph 20.8 Appendix M Table 25 Level 2	Access openings
DW 144 Part 6	Provision of hangers and supports
DW 144 Part 7 Section 21	Regulating damper provision
DW 144 Part 7 section 22	Fire damper supply and installation
DW 144 Part 7 Section 28	Connections to builders work
DW 144 Part 6	Spacing of supports
DW 144 Part Seven Section 22	Intumescent Fire dampers
DW/151	Specification for Plastic Ductwork
DW/171	Guide to Good Practice: for Kitchen Ventilation Systems
DW/191	Guide to Good Practice: Glass Fibre Ductwork
DW/TM1	Acceptance Scheme for New Products: Rectangular Cross Joint
DW/TM2	Guide to Good Practice: Internal Cleanliness of New Ductwork Installations
DW/TM3	Guide to Good Practice for the Design for the Installation of Fire and Smoke
Dampers	
TR/17	Guide to Good practice: Cleanliness of Ventilation Systems

Where references are made to Irish or other International Standard Specifications products shall be selected to meet the system operating conditions.

8. FIRE PROTECTIVE SERVICES

This section covers the supply to site and installation of fire-fighting equipment. The following are the principal Standards which shall apply:

- European Standards EN71-1 and EN694
- B.S. 5306: Part 1
- B.S. 5041; Part 5

Where references are made to Irish or other International Standard Specifications products shall be selected to meet the system operating conditions.

8.1. FIRST AID FIRE EXTINGUISHERS

All Fire Extinguishers shall be as manufactured by Angus; Champion Fire Defence or approved equal and shall be as scheduled. A sign reading 'FIRE POINT' in BOLD lettering on a contrasting background shall be erected over each fire extinguisher. A service record sticker shall be displayed on each extinguisher

The following principal Standard shall apply:

- I.S. 291:2015 Selection, commissioning, installation, inspection and maintenance of portable fire extinguishers.

8.2. FOAM INLETS

Provide Inlet Box to B.S. 5041; Part 5 and Outlets, as supplied by Angus or approved equal. Inlet to be compatible with (State County Council Name here) Fire Brigade Equipment. Installation shall be to B.S. 5306: Part 1 and Building Regulations 1997. Pipe-Work shall be galvanised.

9. VIBRATION ISOLATION

9.1. GENERAL

The requirements for plant isolation are based on achieving the relevant noise criteria.

Air handling units, pumps and boilers should include vibration isolation such that the stated isolation efficiencies are achieved.

Except where stated the specifications given assume a nominal slab thickness of at least 250mm with a maximum span between supports of 9m.

9.2. AIR HANDLING UNITS

The fan stages of all air handling units and extract fans should be isolated from the casing by means of internal spring vibration isolating mounts. If enclosed type mounts are used, care should be taken to install them such that they are evenly loaded to prevent bridging of the upper and lower mount casings.

The effective isolation efficiency of the vibration isolating mounts should be as follows:

Details Isolation Efficiency

- Centrifugal fan > 25hp 98%
- Centrifugal fan < 25hp 96%

When mounted from the floor, fan units and their base frames should be supported at a height not less than 100mm above the concrete slab.

All fan units should be separated from their supports by vibration isolating strips or pads providing a minimum static deflection of 3mm under the imposed load.

Flexible connections should be included between the fan discharge and the casing discharge flange. The connections should have an operating length of 100mm and should have minimum sag under negative pressure.

Ductwork should be supported using vibration isolating hangers giving a minimum static deflection of 8mm under the imposed load, for a minimum distance equivalent to 10 duct diameters from the unit itself.

9.3. PUMPS

All pump sets should be provided with concrete inertia bases with a weight at least 1.5 times the weight of the pumps they are supporting. Pumps should be mounted in pairs (running and standby) on the same slab-base. The inertia bases should be designed with sufficient strength and rigidity to support the equipment and compensate for dynamic reaction due to the equipment.

All pump sets should be provided with open-coil spring vibration isolating mountings under the inertia bases. These should be provided with neoprene (or similar approved) noise stop pads at least 6mm thick.

The effective isolation efficiency of the installed vibration isolating mounts should be as follows:

Details Suspended Concrete Floor Solid Floor

Pumps > 5hp 98% 96%

Pumps < 5hp 96% 94%

With the vibration isolating mountings fully deflected under the weight of the plant, there should be a minimum clearance of 18mm from the underside of the inertia block to structural floor.

All smaller in-line type pumps should only be fixed to the structure by isolated fixing bolts.

All pipework from pumps should be supported for a distance equivalent to 100 pipe diameters, using vibration isolating hangers giving a minimum static deflection of 8mm under the imposed load. Pipework should also include suitable flexible connectors.

9.4. BOILERS

- Boilers should be mounted on vibration isolating pads giving a minimum static deflection under the imposed load of 6mm.
- Supports for boiler flues carried on walls or floors common to noise sensitive areas should incorporate a resilient sleeve between the flue and the support bracket

ISSUE REGISTRATION:

Project: Cahir Market Centre

Project No: 21ME006

Rev	Date	Purpose of Issue/Nature of Revision	Prepared by	Issue Authorised by
T1	18.03.26	TENDER	P.P.	P.P.

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