7 THERMAL INSULATION

7.1 GENERAL

7.1.1 Scope of Work

1 This Part details the requirements for insulation for piping systems, ductwork systems, and equipment.

2 Related Sections and Parts are as follows:

This Section
Part 5 Chilled Water Pipework

Section 1 General

7.1.2 References

1 The following standards are referred to in this Part

ANSI 331.1 .....Pipework Design

ASTM E-84.....Test Method for Surface Burning Characteristics of Building Materials

BS 476.....Fire tests on building materials and structures

BS 4735.....Laboratory method of test for assessment of horizontal burning characteristics of specimens no larger than 150 mm x 50 mm x 13 mm (nominal) of cellular plastics and cellular rubber materials when subjected to a small frame (ISO 3582)

DW 144 .....Ductwork Installation

7.1.3 Submissions

1 The Contractor shall submit manufacturer's specifications and installation instructions for each type of mechanical insulation. The submittal shall include a schedule showing manufacturer's product number, thickness and recommended furnished accessories for each system requiring insulation.

2 Samples for each type of insulation shall be provided. A 300 mm long sample of each piping insulation type and a 300 x 300 mm of each duct and equipment insulation type.

3 The Contractor shall submit certification and data necessary to show compliance with the specification and other governing regulations. These shall include proof of compliance for test of products for fire rating, corrosive resistance and compressive strength.

4 Where the specification calls for additional treatments such as wrapping and water proofing a complete sample shall be provided in addition to the above samples.

5 All samples shall be retained on site after approval to be a reference for future work.

7.1.4 Contractor's Responsibility

1 The Contractor shall provide all necessary materials, labour, equipment, tools, appliances, services hoisting scaffolding supports and supervision to provide complete mechanical insulation in accordance with the Specifications.

7.1.5 System Description

1 The thermal insulation shall be in accordance with the QGEWC regulations unless specified differently in the Project Documentation. However QGEWC approval is required before any change will be permitted.

2 The whole of the insulation work shall be carried out by an approved specialist insulation Contractor. All allowances shall be included for arranging a specialist subcontractor accordingly and for informing the specialist subcontractor of all conditions relating to the contract and for co-ordinating his works with the remainder of the Works.

3 All allowances shall be included for informing the specialist subcontractor of all details of the building structure, programme arrangements, and other relevant details at the time of tender and for all necessary visits to site by the subcontractor or his workers.

4 In addition to complying with the relevant standards, all insulating material shall be free from asbestos.

5 Insulating materials shall be acceptable only if they are equal to or better than the grades or classes of fire resistance as follows:

(a) BS 4735, Class Q, for burning rate nil, and not producing melted droplets

(b) BS 476 Part 4, for non-combustible grade

(c) BS 476 Part 5, Class P, for not easily ignitable

(d) BS 476 Part 7, for fire propagation index of a maximum of 12.6

(e) BS 476 Part 7, Class 1, for surface spread of flame

(f) BS 476 Part 9, for production of emitted smoke shall not give more than 35 % obstruction of the light beam.

6 All insulation finishes and coverings shall be classified as Class 1 surface spread when tested in accordance with BS 476, Part 7.

7 All adhesive, mastics, coatings, sealers and primers shall be classified as Class 1 surface spread when tested in accordance with BS 476, Part 7. They shall not in any way attack the insulation or the surface to which the insulation is being applied and shall be suitable for the working temperatures.

8 Insulating materials shall have thermal conductivity values not more than those listed as given in Table 8.1.

Table 8.1
Thermal Conductivity Insulating Materials

Material	Type	Thermal Conductivity (W/m/°C)
Mineral wool	Sectional	0.04
Mineral wool	Slabs	0.04
Fibre Glass	All	0.034
Closed Cell	All	0.038
Polyurethane	Sectional	0.025
Styrofoam	Rigid	0.026

Note: all conductivity figures are rated at an average temperature of 24 °C.

9 All material delivered to site shall be new and fully dried out and so maintained throughout the progress of the works. All insulating materials shall be stored in storage sheds, and in accordance with the manufacturer's recommendations.

10 In order to ensure that the insulation applied is in all respects in accordance with the Specification, sections shall, as required by the Engineer, be cut from the finished insulation. The Contractor is as allow in his price for the removal and replacement of two sections of each type of insulation. If however, defects are revealed, further sections shall be cut out for inspection, and all cut-out sections shall be replaced at no cost to the Contract. If further defects are revealed then the Engineer shall have the right, when in his opinion it is necessary, to issue instructions for any part or the whole of the insulation to be removed and replaced. The replacement with new insulation shall be to the satisfaction of the Engineer and the cutting out and replacement shall be at no cost to the Contract.

11 Particular attention shall be paid to the finished appearances of all thermal insulation which must present a neat and symmetrical appearance running true in the line with pipe layouts, etc.

12 Any rough, irregular and badly finished surfaces shall be stripped down and re-insulated to the Engineer's satisfaction.

13 In certain cases the type of insulation specified will require a painted finish, in addition to identifying bands and any signs which are to be applied.

14 All systems are to have been tested and approved by the Engineer prior to installation of insulation.

15 All thermal insulation shall be non-corrosive to the metal, water repellent and fire retardant.

16 All metal surfaces shall be thoroughly cleaned and treated with approved corrosion inhibitor before applying the insulation. Insulation can be applied directly to galvanized surfaces.

17 Lead bearing inserts shall be provided at all supports to ensure that the insulation is not compressed or damaged. The inserts shall be treated hardwood or approved plastic.

18 The vapour barrier shall be continuous and not punctured at any point.

19 The cotton canvas/fibre glass cloth shall be soaked in a compound as approved by the Engineer and shall be overlapped at least 50 mm at transverse and longitudinal cloth joints.

20 Vapour seal materials shall be fire resistant, non-toxic, weather resistant, and anti-fungus quality. Bitumen based products shall not be used.

21 All access doors in ductwork shall be insulated to match the ductwork that they are installed in. The insulation shall be furnished to allow access without damage to the insulation.

22 Mechanical fasteners shall be used when installing slab or roll insulation. The fasteners shall be the self adhesive type and only fixed after cleaning to ensure proper adhesion.

7.2 PIPE INSULATION

7.2.1 Fibreglass Insulation

1 Pipe covering and insulation shall be manufactured by a recognised manufacturer, and shall be neatly installed to the following specifications. The general intent is to provide a sealed insulation which will not permit sweating of the pipes and which will not retain moisture to the detriment of it's insulating capability.

2 Pipes shall be thermally insulated with rigid section of fibre glass insulation with density of 65 kg/m3, having a thermal conductivity factor of 0.03 W/m2/K at 10 oC with self applied aluminium craft paper. The minimum thickness shall be 500 mm unless otherwise specified in the Project Documentation.

3 The insulation, in sizes indicated shall be applied over clean, dry surfaces. Adjoining sections of insulation should be butted firmly together with the longitudinal seam of the jacket located on the bottom half of the pipe.

4 Pipes should be banded with at least three aluminium bands per section. One at the centre and one covering the edge of each circumferential strip.

5 Insulate and finish valves and fittings in the same manner and same thickness as piping in which such items are installed. Moulded, factory shaped sectional pipe covering, factory or job fabricated may be used subject to satisfactory visual checking by the Engineer.

6 Direct contact between pipe and hanger shall be avoided. Hangers shall pass outside of the sheet metal protection saddle, which shall cover a section of high density insulation, of sufficient length to support the pipe without crushing the insulation. The vapour barrier shall be lapped over the saddle and securely cemented to it. Minimum thickness of metal saddle is 1.5 mm. The method shall be in accordance with DW 144.

7 Internal chilled water pipe shall be covered by 50 mm of rigid insulation plus a 200 g/m2 woven glass cloth cover painted with two coats of approved sealant. External chilled water pipe shall be covered by 50 mm of rigid insulation plus a waterproof cover of 200 g/m2 woven glass cloth painted with two coats of approved sealant. Where any insulated piped service is run external to the building (including insulated pipework run on roofs), in trenches or in plant rooms, the piped services shall be clad using an outer covering of sheet aluminium with a minimum thickness of 0.7 mm.

8 Where exposed, insulated pipework runs through occupied or public areas, chiller yards and plant rooms the exposed pipework shall be clad with sheet aluminium, of 0.7 mm or thicker. or may be painted as detailed in the Project Documentation.

9 Strainers and valves of diameter 80 mm and above and fittings which require opening for maintenance and repairs shall be provided with insulated boxes.

7.2.2 Polyisocyanurate (Phenolic Foam) Insulation

1 Chilled water pipe insulation shall be polyisocaynurate rigid closed cell pre-formed pipe insulation cut from blocks which have been factory produced from a chemical system complying with ASTM E-84, with a flame spread less than 25 and identified by a light green colour.

2 The density shall be 35 kg/m3 for all interior piping and 50 kg/m3 for external pipework.

3 All pipe insulation to be factory covered with reinforced aluminium foil/kraft paper laminate, the whole providing a Class I rating to BS 476 Part 7.

4 Bends are to be insulated with pre-moulded polyisocyanurate rigid closed cell foam meeting the same fire ratings as above but with aluminium foil applied separately on site.

5 Tees, valves, strainers etc. are to be produced by the Contractor forming suitable metal boxes and pouring in-situ polyisocyanurate chemical system supplied by the pipe insulation manufacturer and in accordance with his instructions.

6 High density pipe supports, 80 kg/m3, are to be produced from the same chemical system and by the same manufacturer of the insulation and covered with aluminium foil in the factory.

7 The manufacturer's installation recommendations shall be strictly adhered to.

8 The use of fibrous insulation on chilled water pipes will not be permitted.

7.2.3 Preinsulated Under Ground

1 All underground chilled water pipework shall be pre-insulated.

2 The system shall be non corrosive, non metallic, structurally strong completely water proof and entirely resistance to attack by salts, water and all ground chemicals normally encountered.

3 The system manufacturer shall have fabricated systems of the composition defined here for at least two years.

4 All straight sections fittings, anchors end seals and other accessories shall be factory prefabricated to the project dimensions. The design shall be such to minimise the number of field welds.

5 The system design shall be in conformance with the latest edition of ANSI 331.1.

6 Pipe movement due to thermal expansion shall be accommodated with expansion loops or elbows.

7 The system manufacturer shall provide an integrated leak detection/location system factory installed within the piping system. The leak detection system shall be connected to the leak detection panel.

8 The complete system shall be computer designed and analysed by the piping system manufacturer to determine stress and anticipated thermal movement of the pipework.

9 PVC warning tape shall be provided 300 mm above the buried throughout the length of the buried pipe.

7.3 CONCEALED COLD AIR DUCTS

7.3.1 Fibreglass Insulation

1 Unless otherwise indicated, supply and return ductwork shall be insulated with 48 kg/m3 density aluminium foil faced fibreglass duct insulation. The insulation shall be fastened with adhesive of high quality and a thermal conductivity of not more than 0.037 W/m/°C. The adhesive shall be applied to the entire surface of the ductwork and insulation. Butt all joints tightly and seal all breaks and joints by adhering a 75 mm aluminium foil vapour barrier tape or sheet with a fire retardant adhesive.

2 Insulate flexible connections and connections to diffusers with 25 mm thick, 24 kg/m3 density reinforced aluminium foil faced, flame resistant, flexible fibreglass insulation. Overlap onto adjacent insulation and seal with adhesive duct tape to give good closure.

3 Finish insulation on ductwork by applying a 200 g/m2 canvas cover adhered between two coats of approved fungicidal protective fire resistant lagging adhesive.

4 Bitumen based products shall not be used.

7.3.2 Polyisocyanurate (Phenolic Foam) Insulation

1 Unless otherwise indicated insulate supply and return ductwork with 25 mm of 35 kg/m3 non-hygnoscopic foil faced polyisocyanurate (phenolic foam) slabs.

2 Flexible connections shall be insulated with 25 mm of 24 kg/m3 reinforced flame resistant flexible fibreglass insulation.

3 The insulation shall be fixed by means of a non flamable adhesive recommended by the insulation manufacturer.

4 Finish insulation on duct work by applying a 200 g/m2 canvas cloth cover adhered between two coats of approved fungicidal protective fire resistant lagging adhesive.

7.4 EXPOSED COLD AIR DUCTS

7.4.1 Fibreglass Insulation

1 For ducts exposed inside conditioned spaces, insulate as described above for concealed air ducts but using aluminium foil faced fibre glass boards with density 48 kg/m3. Then apply a 200 g/m2 canvas cover adhered between two coats of approved fungicidal protective fire resistant lagging adhesive.

2 Where exposed cold air ductwork runs through occupied or public areas, it shall be clad with sheet aluminium, 0.9 mm or thicker as specified in the Project Documentation.

3 For ducts exposed in non air conditioned areas and plant rooms, insulate using the method described for concealed ducts, but using insulation with a minimum thickness of 50 mm, 48 kg/m3 density fibreglass insulation. If necessary due to market availability, this may be installed in two layers, but with each layers, but with each layer properly finished.

4 Finish insulation by applying a 200 g/m2 canvas cover adhered between two coats of approved fire resistant lagging adhesive.

5 Where ducts penetrate the building shell, the duct shall be flashed and waterproofed before any insulation is applied.

7.4.2 Polyisocyanurate (Phenolic Foam) Insulation

1 Exposed ductwork inside air conditioned spaces shall be insulated as described above for concealed duct work.

2 Exposed ductwork in non-air conditioned areas, insulate using the method described for concealed ducts but using insulation with 50 mm of 35 kg/m3 polyisocyanurate (phenolic foam) insulation. This may be installed in two layers, but with each layer staggered and properly finished.

3 Finish insulation on duct work by applying a 200 g/m2 canvas cloth cover adhered between two coats of approved funigicidal protective fire resistant lagging adhesive.

4 The finished insulation shall then be clad with aluminium sheet 0.9 mm thick.

5 Where ducts penetrate the building the duct shall be flashed and waterproofed before any insulation is applied.

7.4.3 External Ductwork

1 All external ductwork shall be insulated with 50 mm thick fibre glass slab.

2 The insulation shall be installed as detailed for exposed ductwork except that the insulation shall be covered with fibre glass cloth 200 g/m2.

7.4.4 Acoustic Lining

1 Acoustic lining shall be provided when specified in the Project Documentation.

2 The lining shall be glass fibre or mineral wool slab and faced to minimise fragmentation and fibre fly. The type and thickness of the lining shall be approved by the Engineer.

3 The ductwork shall be size to allow for the thickness of the lining.

4 The ductwork surfaces must be thoroughly cleaned and the lining fixed by an approved adhesive over the whole area to be lined.

5 Mechanical fasteners must be used at 400 mm maximum centres and not more than 75 mm from joints, corner breaks etc.

6 All edges shall be sealed or enclosed by a light metal section mechanical fastened to the duct.

7 If required by the Engineer, metal mesh may be required as a precaution against displacement or break up.

7.4.5 Circular Duct Insulation

1 Circular supply and return air ductwork shall be insulated with flexible fibre glass blanket of density 24 kg/m3 and covered with reinforced aluminium foil

2 Blanket thickness shall be 50 mm compressed to 25 mm during installation for internal ducts and 100 mm compressed to 50 mm for external ducts.

3 The method of installation shall be the same as for rectangular ducts.

4 Aluminium bands 25 mm wide shall be installed at 500 mm centres

5 Vapour sealing shall be carried out as specified for rectangular ducts

6 Additional protection shall be provided for exposed ducts if specified in the Project Documentation.

7.5 EQUIPMENT INSULATION

7.5.1 Refrigerant and Condensate Drain Pipe Insulation

1 The pipe covering and insulation shall be manufactured by a recognised manufacturer and shall be neatly installed to the following specification. The general intent is to provide a sealed insulation which will not permit sweating of the pipes and which will not retain moisture to the detriment of its insulating capability.

2 The refrigerant suction lines only shall be insulated with 19 mm thick foam rubber having a thermal conductivity factor of 0.036 W/m2/K and a maximum water permeability of 0.09 µgm/NH. Alternatively, the pipes shall be insulated with 50 mm thick rigid fibreglass insulation and vapour sealed in the same manner as chilled water pipes as detailed in Part 5 of this Section.

3 The material shall be supplied as pre-formed pipe sections in tubular or pre slit form.

4 The insulation shall be installed accordingly to the manufacturer’s recommendations using a non-flammable adhesive.

5 All exposed insulation shall be given two coats of chlorosulphonated polyethylene paint.

6 All condensate drains within plant rooms or other internal areas subject to damage or sweating shall be insulated using 25 mm thick rigid fibreglass or 10 mm thick foam rubber insulation. The insulation shall be vapour sealed as for chilled water pipes as detailed in Part 5 of this Section.

7.5.2 Apparatus Casings

1 Insulate apparatus casings which are not provided with insulation as follows:

2 apply generally 50 mm of rigid polyurethane insulation, 24 kg/m3 density. On the underside of coil sections, apply 50 mm thick polyurethane insulation, 24 kg/m3 density. All joints are to be sealed in cold adhesive compound.

3 Ensure that any access panels are insulated to the same standard and are openable.

4 For small units, cover the entire outside assembly with waterproof self adhesive glass fibre tape. This must be at least 75 mm minimum width and must overlap at least 50 % on each application, to achieve watertight conditions.

5 For larger units, provide a weather resistant enclosure outside the insulation, subject to Engineer's approval.

6 Ensure that all equipment meets these requirements, regardless of manufacturer's standard practice, and add insulation as required to the above standard.

7 Where insulation, re-installation or additional insulation is required to the casing of externally mounted air conditioning units, the insulation shall be covered with sheet Aluminium, of 0.9 mm or thicker.

8 Insulation of drain pans is specified for AHU and FCU regardless of the manufacturer's standard supply, the contractor shall re-insulate on site if necessary so that the specification is complied with in full.

END OF PART