

**SECTION 15190****MECHANICAL IDENTIFICATION****PART 1 GENERAL****1.01 SCOPE OF SECTION**

- A. This Technical Specification establishes the type and quality of materials and the standard of workmanship to be used in the supply and installation of Mechanical Identification systems.

**1.02 WORK INCLUDED**

- A. The work includes the provision of all labour, materials and the performance of all operations in connection with the supply and installation of Mechanical Identification systems as specified herein and where referred to on the Drawings.
- B. Coordination: The Contractor shall be responsible for the full coordination of the work of all trades.

**1.03 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in the manufacture of Mechanical Identification systems whose products have been in satisfactory use for a similar application and not less than 10 years.
- B. Installer: Firms regularly engaged and qualified in the installation of Mechanical Identification systems with at least 5 years successful installation experiences on projects of a similar nature.

**1.04 APPLICABLE CODES AND STANDARDS**

- A. Mechanical Identification systems and all associated materials and workmanship shall comply fully with the latest relevant British Standards in all respects.

The following are the most commonly used and relevant British Standards associated with pipework products and associated materials. However, the Contractor shall ensure that all applicable British Standards are complied with whether listed here or not.

BS 1710 - Specification for Identification of Pipelines and Services.

BS 4800 - Specification for Paint Colours for Building Purposes.

## 1.05 SUBMITTALS

- A. Drawings refer to 15010
- B. Products: Full manufacturers colour data for each product.
- C. Samples - Full - size colour sample of pipework and ductwork identification.

## 1.06 OPERATION AND MAINTENANCE DATA

- A. Comply with 15010
- B. Mechanical identification system shall correspond totally to "As Built" data.

## 1.07 WARRANTY

- A. Provide 12 months warranty in accordance with contract conditions.

**PART 2 PRODUCTS**

## 2.01 PLANT AND PIPEWORK IDENTIFICATION

- A. All pipework shall be colour coded in accordance with BS 1710 as detailed in Table 1.

TABLE I

IDENTIFICATION OF PIPELINES

Pipe contents	Colour code indication (approx 100mm)	Basic colour (approx 150mm)
Drinking Water	To BS 1710	Blue
Cold water down service	To BS 1710	Green
Hot water supply	To BS 1710	Green
Drainage	To BS 1710	Black

- B. Identification to pipework shall consist of 100mm PVC adhesive bands over the basic colour and shall include flow direction arrows together with the abbreviation of the service name. All coding requirements are to be agreed with the Engineer.

C. Code indication for safety conditions shall be as follows:-

Safety Colour	BS colour reference BS 4800
Red	04 E 53
Yellow	08 E 51
Auxiliary Blue	18 E 53

Safety colour references are as follows:-

1. Red for fighting equipment.
2. Yellow with black diagonal stripes for warning of danger.
3. Yellow with trefoil symbol for ionizing radiation (as defined in BS 3510).
4. Auxiliary blue in connection with green basic colours, to denote pipes carrying fresh water, either potable or non-potable.

Safety colour references shall be applied using 100mm wide sections of PVC adhesive band in all permanent locations, to be agreed with the Engineer.

Colour references shall include notation as follows:-

1. FIRE
2. DANGER
3. RADIATION
4. POTABLE OR NON-POTABLE

In the case of fire service, all equipment, i.e. valves, suction tanks, etc., shall also be painted red.

- D. Uninsulated pipework shall be painted with one coat of undercoat and two coats of gloss finish to the relevant BS colour.
- E. Valve identification shall be by means of 40mm diameter trafficite discs of white/black/white composition. Letters and figures of 8mm minimum height, identifying the service and valve number shall be engraved into the material. A 3mm diameter hole shall be drilled through the disc for the purpose of securing the disc to the valve.

- F. Plant identification shall be by means of traffalyte labels of white/black/white composition. Letters and figures of 8mm minimum height identifying the plant shall be of a size to be agreed with the Engineer. A minimum of two 3mm diameter holes shall be drilled through the label to the plant.
- G. All plants shall carry the manufacturer's identification plate which shall incorporate all details of electrical and mechanical duties.

## 2.02 DUCTWORK IDENTIFICATION

- A. Ductwork shall be colour coded in accordance with HVAC Specification DW142 to the colours indicated in Table 2. For conditioned air, identification shall comprise either of two symbols (one red, one blue) or a single symbol coloured, part red, part blue.

TABLE 2

DUCT IDENTIFICATION COLOURS

BS 4800	Colour	Type
04353 / 18E53	Red and Blue	Conditioned Air
10E53	Yellow	Warm Air
14E53	Green	Fresh Air
AA009	Grey	Exhaust / extract recirculated air
06C39	Brown	Foul Air

- B. Direction of flow shall be by PVC self adhesive equilateral triangles with one apex pointing in the direction of flow. The minimum length of side of the triangle shall be 150mm.

## PART 3 EXECUTION

### 3.01 STORAGE

- A. All identification materials shall be stored within a well lit container or purpose made compartmented racks or shelving. The material shall be adequately covered to prevent damage and ingress of dirt.

### 3.02 GENERAL

- A. Identification shall be placed where it can be easily seen and at positions where identification will be required. To ensure that the symbols are seen, the following points shall be considered:-
1. The symbols shall be on the surface which faces the positions of normal access to the completed installation.
  2. The symbols shall not be hidden from view by structural members, other ducts, plant or other services distribution systems.
  3. The symbols shall be placed where there is adequate natural or artificial light.
- B. Symbols shall occur frequently enough to avoid the need for ducts and pipes to be traced back. Symbols should be placed at any service and access points to the distribution system.
- C. Identification shall be applied to pipework and ductwork at every entry and exit point to a room but in no case of intervals of less than 12m.

### 3.03 PLANT AND PIPEWORK IDENTIFICATION

- A. In addition to the colour bands, all pipework in plant rooms and service areas, whether insulated or not, shall be legibly marked with black or white letters to indicate the type of service and the direction of flow. Services shall be identified as follows:-

Refrigerant:		RFG
Cold Water:	Raw	RW
	Sweet	SW
Domestic Hot Water:	Raw	RW
	Sweet	SW
Fire Main:		FM
Gas:		GAS

- B. The basic identification colour shall be applied using a PVC adhesive band either applied to pipework insulation or pipe when uninsulated. Identification shall be placed at all junctions, at both sides of valves, services appliances, bulkheads, wall penetrations and at any other places where identification is necessary or advantageous.
- C. Where pipes are run in pairs, the letters F and R shall be added to indicate flow and return respectively.

**3.04 DUCTWORK IDENTIFICATION**

- A. All ductwork in plant rooms and services areas, whether insulated or not, shall be legibly marked with black or white letters to indicated the type of service and the direction of flow. Services shall be identified as follows:-

Supply Air - S

Return Air - R

Fresh Air - F

Exhaust - E

- B. Ductwork identification shall be applied to ductwork whether insulated or not, at all branches, plant connections, wall penetrations and at any other place where identification is necessary or advantageous.

**END OF SECTION 15190**

**SECTION 15291****HVAC THERMAL INSULATION****PART 1 GENERAL****1.01 SCOPE OF SECTION**

- A. This technical specification establishes the type and quality of materials and the standard of workmanship to be used in the supply and application of thermal insulation for HVAC items.

**1.02 WORK INCLUDED**

- A. The work includes the provision of all labour, materials and the performance of all operations in connection with the supply and application of thermal insulation as specified herein and where referred to on the Drawings.
- B. Coordination: The Contractor shall be responsible for the full coordination of the work of all trades.

**1.03 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in the manufacture of thermal insulation materials whose products have been in satisfactory use for a similar application for not less than 10 years.
- B. Installer: Firms regularly engaged and qualified in the application of thermal insulation materials with at least 5 years successful installation experience on projects of a similar nature.
- C. No thermal insulation shall be applied to pipework and ductwork services until the installations have been inspected by the Engineer and tested in accordance with the relevant sections of this specification.

**1.04 APPLICABLE CODES AND STANDARDS**

- A. The thermal insulation products and all associated materials shall comply with the latest relevant British Standards in all respects.
- B. The following are the most commonly used and relevant British Standards associated with thermal insulation products and associated material. However, the Contractor shall ensure that all applicable British Standards are complied with whether listed here or not.

BS 476 Part 4 : Non-combustibility Test for Materials.

BS 476 Part 7 : Method for Classification of the Surface Spread of Flame of Products

BS 476 Part 20	:	Method for Determination of the Fire Resistance of Elements of Construction.
BS 1485	:	Specification for Zinc Coated Hexagonal Steel Wire Netting.
BS 3958 Part 3	:	Metal Mesh Faced Man-made Mineral Fibre Mattresses.
BS 3958 Part 4	:	Bonded Preformed Man-made Mineral Fibre Pipe Sections.
BS 3958 Part 5	:	Specification for Bonded Man-made Mineral Fibre Slabs.
BS 5422	:	Specification for the use of Thermal Insulation Materials.
BS 5970	:	Code of Practice for Thermal Insulation of Pipework and Equipment.

#### 1.05 SUBMITTALS

- A. Drawings refer to 15010
- B. Products: Full manufacturers data confirming type and composition of all products including thermal characteristics.
- C. Samples - Section of insulated duct  
- Section of insulated pipe  
  
both showing detail of resilient spacer at bracket location.

#### 1.06 OPERATION AND MAINTENANCE DATA

- A. Comply with 15010

#### 1.07 WARRANTY

- A. Provide 12 months warranty in accordance with contract conditions.

### PART 2 PRODUCTS

#### 2.01 GENERAL

- A. For general applications the thermal insulation materials shall be made from materials which will not burn, but materials which are not entirely non-combustible may be accepted if they have self-extinguishing characteristics, the



total mass of combustible materials is small and combustion does not produce dense smoke or toxic fumes. All material finishes shall conform to spread of flame classification class O. Such materials shall only be used with the prior permission of the Engineer.

- B. Insulation shall be rotproof, odourless, non-hyrosopic, shall not sustain vermin and shall not contribute to metal corrosion. Any finishes (or coverings) used shall not deteriorate with age or the effects of solar heat.
- C. Thermal insulation materials and their finishes shall be asbestos free and be suitable for continuous use throughout the range of operating temperatures and within the environment indicated.
- D. All insulating materials and associated products, sealants, tapes, adhesives, securing bands and protective cladding shall be as specified or equal and approved.

## 2.02 DUCTWORK INSULATION

- A. Thermal insulation of rectangular ductwork shall be rigid mineral fibre slab consisting of long fine fibres (free from short and coarse fibres) bonded with a temperature resistant resin. The density shall be a minimum of 48 Kg/m<sup>3</sup>.
- B. Thermal insulation of circular ductwork shall be flexible mineral fibre material consisting of long fine fibres (free from shot and coarse fibres) made up in mat form. The density shall be a minimum of 32 Kg/m<sup>3</sup>.
- C. Thermal insulation on ductwork etc. inside buildings generally shall be at least 25mm thick where its declared value of thermal conductivity at the relevant temperature is equal to or less than 0.04 W/m deg. C or at least 38mm thick where the declared value of thermal conductivity is between 0.04 and 0.06 W/m deg. C. In the open air, in plant rooms and in large unconditioned open areas of buildings, the thermal insulation shall be at least 50mm thick where the thermal conductivity is less than or equal to 0.04 W/m deg. C or at least 63mm thick where the thermal conductivity is between 0.04 and 0.06 W/m deg. C.

For ductwork carrying chilled air, the insulation shall cover the flanges either by means of flange boxes or by increasing the general thickness of insulation to give at least 6mm cover at the flanges.

- D. All ductwork thermal insulation shall be complete with a reinforced aluminium foil applied to one side during the manufacturing process.
- E. Where integral or surface reinforcement is called for, or required in connection with insulation materials, it shall be one or other of the following:
  - i. Galvanised wire netting of not less than 0.914mm. diameter and 22mm mesh size.

- ii. Galvanised wire, either 0.914mm diameter spirally wound at approximately 75mm pitch or 1.219mm diameter when used in single strands at right angles to the axis of duct (or pipe).
  - iii. Aluminium bands 20mm wide by 0.51mm thick, with galvanised wire end loops.
  - iv. Aluminium or galvanised steel edge reinforcement strips secured to the insulation with adhesive.
- F. Where there is a requirement to prevent noise transmission through the walls of the ductwork, either in the form of noise break-out prior to an attenuator, noise break-in on the attenuated side, acoustic insulation shall be applied to the external surface of the ductwork. The acoustic insulation shall be of an approved noise control barrier of mineral fibre with a minimum density of 48 Kg/m<sup>3</sup>. The acoustic insulation shall be at least 50mm thick and the thermal conductivity less than or equal to 0.04 W/m °C.
- G. Where there is a requirement to internally line the ductwork to attenuate airborne noise the acoustic lining material shall be of an approved noise control barrier of mineral fibre faced to prevent fragmentation with a minimum density of 48 Kg/m<sup>3</sup>. The acoustic lining shall be at least 50mm thick and the thermal conductivity less than or equal to 0.04 W/m °C.

## 2.03 PLANT AND PIPEWORK INSULATION

- A. Thermal insulation shall be pre-formed rigid sections or slabs, the basic material consisting of the following:
- \* Rockwool mineral fibre (density 110-160 Kg/m<sup>3</sup>).
  - \* Thermal conductivity 0.040 w/m deg C.
- The insulation shall be manufactured from long stranded mineral fibres, resin bonded to form sections having uniform density and high compressibility. The preformed rigid insulation outside surface shall be smooth, unbroken, uniform, concentric and firm.
- B. Pipework insulation shall be high density rigid resin bonded preformed rockwool mineral fibre sections of the thickness specified. The insulation shall comprise of two half sections with a factory applied reinforced aluminium foil covering hinging the two half mating sections for ease of installation. The covering shall have a 50mm side overlap of reinforced aluminium foil to enable the outside surface to be completely sealed.
- C. Where thermal insulation of plant is required the insulation shall be preformed rigid sections or slab. The material shall consist of long fine fibres (free from shot and coarse fibres) bonded with a temperature resistant resin. The density shall be a minimum of 48 Kg/m<sup>3</sup> and the surface shall have a factory applied reinforced aluminium foil finish.

- D. Thickness of insulation shall be determined in accordance with the following tables for the appropriate medium and the declared value of thermal conductivity of the insulation material at the relevant temperature.

When selecting the insulation thermal conductivity, the space available for the installation shall be thoroughly examined to ensure that the resultant thickness can be accommodated.

**TABLE 1**

**THICKNESS OF INSULATION FOR CHILLED WATER AND CONDENSATE DRAINAGE PIPEWORK**

DECLARED THERMAL CONDUCTIVITY W/m deg.C	
PIPEWORK WITHIN CONDITIONED SPACES	
SIZE OF TUBE (mm)	UP TO 0.040 W/m deg C Minimum Thickness of Insulation (mm)
15 to 20	32
25 to 50	38
65 to 300	50
Flat Surfaces	50

**TABLE 2**

**THICKNESS OF INSULATION FOR CHILLED WATER AND CONDENSATE DRAINAGE PIPEWORK**

DECLARED THERMAL CONDUCTIVITY W/m deg.C	
PIPEWORK WITHIN UNCONDITIONED SPACES, PLANT ROOMS AND OPEN AIR	
SIZE OF TUBE (mm)	UP TO 0.040 W/m deg. C Minimum Thickness of Insulation (mm)
15 to 20	38
25 to 50	50
65 to 100	63
125 to 300	75
Flat Surfaces	50

## 2.04 REFRIGERATION PIPEWORK INSULATION

- A. Thermal insulation shall be preformed un-slit foamed Class 1 plastic material to suit the size of the pipe. The vapour barrier shall be an integral part of the material. The insulation shall have a thermal conductivity of  $0.0375 \text{ W/m}^{\circ}\text{C}$  and shall be satisfactory for a temperature range of  $0^{\circ}\text{C}$  to  $104^{\circ}\text{C}$  without deformation or deterioration. The minimum thickness of the insulation shall be 25mm.

## PART 3 EXECUTION

### 3.01 STORAGE

- A. All thermal insulation materials shall be stored in their original packaging in such a manner as to prevent the ingress of dust or moisture. The height of the packages shall be restricted to prevent any deformation of preformed rigid sections.
- B. Flat sheet and rolled metal materials used for protective claddings shall be stored away from the ground surface, adequately covered and protected in a manner to prevent damage to the materials.
- C. All storage areas shall have adequate lighting to allow for the inspection of all materials.
- D. Refer to 01600

### 3.02 FIXINGS

- A. All mechanical fixings (rivets, screws) shall be as recommended by the manufacturer of the material being fixed. All mechanical fixings, sealants, tapes and adhesives shall be entirely suitable for the medium that they are being applied to and the application shall be fully in accordance with the manufacturers recommendations.

### 3.03 DUCTWORK INSULATION

- A. Thermal insulation to ductwork shall be carried out neatly and to a high grade quality by skilled workers experienced in the trade, and strictly in accordance with this Specification. No thermal insulation shall be applied to any ductwork prior to completion of any air leakage testing that may be required and only then after a full inspection and approval by the Engineer.
- B. Thermal insulation shall be applied to all supply and return ductwork carrying conditioned air through unconditioned areas including plantrooms. Thermal insulation shall not be installed on the sections of return air ductwork covered with fire resistant cladding.

Supply ductwork carrying conditioned air through conditioned areas shall be insulated, whereas return ductwork passing through conditioned areas shall not be insulated unless otherwise stated.

All ductwork exposed to the atmosphere shall be insulated. All ductwork in plant rooms shall be insulated except return ductwork covered with fire resistant cladding.

- C. All rectangular ductwork shall be insulated with rigid slab, cut to fit so that the top and bottom pieces overlap the sides, bonded to the ductwork with adhesive applied in 100mm bands at 300mm intervals. On ductwork where the width exceeds 900mm, stickpins shall be used on the underside and sides to prevent any excessive sagging.
- D. All circular ductwork shall be insulated with mineral fibre mat bonded to the ductwork with adhesive applied in 100 mm bands at 300 mm intervals.
- E. All joints in the thermal insulation shall be fully sealed to maintain a continuous vapour barrier throughout by the use of 75 mm wide aluminium tape.
- F. Load bearing inserts of hardwood or phenolic foam complete with factory applied vapour seal shall be used at support positions. The inserts shall be of the same thickness as the insulating material and cut such that 50 mm protrudes either side of the support. The rigid slab shall be butt jointed to the insert and the joint fully sealed with 75 mm wide aluminium tape to maintain the vapour seal. The vapour seal shall not be pierced or fouled by the supports, and shall be continuous.
- G. All insulation on ductwork carrying conditioned air shall have a continuous vapour seal.
- H. The insulation on ductwork exposed to view and within plantrooms shall be clad totally in an aluminium stucco finish cladding 0.8mm thick with folded corners and held in place by means of rivets or self tapping screws. All joints shall be sealed with a non-setting sealing compound.
- J. All ductwork exposed to the outside atmosphere shall be insulated and clad as for plant rooms.
- K. Where ductwork passes through masonry walls, floors and roofs a sheet metal sleeve shall be installed and the gap, equal to the insulation thickness, shall be packed with a load bearing insert with integral vapour seal. The thermal insulation shall be butt jointed to the insert and the joint sealed by the use of 75 mm wide aluminium tape. All openings through external walls and roofs shall be fitted with a flashing fixed to ensure water will not enter the insulated space between the ductwork and the cladding.
- L. Where the insulation is 50 mm thick or more (except for insulation which is sprayed or moulded in situ) the insulation shall be fixed in two layers with joints

staggered. For air heaters using media at high temperature the thermal insulation material shall be suitable for use at those temperatures.

- M. All joints, surfaces, edges and overlaps shall be neatly finished and where possible overlaps shall be arranged on the 'blind' side. Overlaps shall be even and parallel to the circumferential and longitudinal joints. Insulation shall be neatly shaped around flanged joints, access openings etc., irregular joints, surfaces, edges and overlaps will not be accepted by the Engineer in any circumstances.

Until final acceptance of the installation by the Engineer, the Contractor shall make good any damage to insulation at his own expense, so that the installation is handed over in a perfect conditioned.

- N. Where an acoustic lining to ductwork is specified, it shall be fitted in the workshop. Before manufacture, confirmation shall be obtained that the dimensions of the duct allow for the thickness of the lining.

Duct surfaces must be thoroughly clean and the lining fixed by an approved type of adhesive applied over the whole of the area to be lined. In addition, fasteners must be used at 450mm maximum centres, and not more than 75mm from joints, corners, breaks etc. with washers or caps to hold the lining. Metal mesh may be called for by the Engineer as an additional precaution against displacement or break-up of the lining.

The lining must be applied so as to provide abutment at joints and edges, with continuity of facing material. For protection prior to erection, the edges of the lining shall be sealed or enclosed by a light metal section mechanically fastened to the duct.

- O. All attenuators and diffuser plenums shall be insulated and vapour sealed to the same specification as the ductwork connecting to them except diffuser plenum boxes specified as having internal acoustic/thermal insulation.

### 3.04 PLANT AND PIPEWORK INSULATION

- A. Thermal insulation to pipework shall be carried out by specialists and strictly in accordance with this Specification. No thermal insulation shall be applied to pipework prior to witnessing of the pipework pressure test and only then after a full inspection and approval by the Engineer.
- B. Thermal insulation shall be applied to the following:-
- (i) External distributing mains and fittings above ground and in ducts, chases and trenches including all valve bodies and flanges.
  - (ii) Buried pipework shall have special forms of insulation as indicated.
  - (iii) All condensate drainage pipework to prevent shedding of condensation.

Insulation shall fit closely on pipework and other surfaces without gaps between.

- C. All sections of the insulation shall be of the correct size and made for the type and grade of piping to which it is fitted and shall form a tight fit on the pipework after application of adhesive and lapping.
- D. Each pre-formed rigid insulation section shall be butt jointed to the next, the point being fully sealed with 75 mm wide aluminium tape. The preformed sections on domestic hot and cold water services shall be secured hard to the bracket where inserts are not used. The reinforced aluminium side overlap shall be sealed with a suitable adhesive or 75 mm wide aluminium tape. Outer coverings shall not come into contact with pipework and attachments.
- E. Each section of pre-formed insulation shall be secured to the pipe by one of the following means:
  - \* Circumferential tie wires each formed from three turns of wire not less than 1 mm thick, spaced not more than 450 mm apart.
  - \* Circumferential bands of non-ferrous metal, plastic fibre or adhesive sheet.
  - \* Rigid insulation applied to cylinders and flat surfaces shall be secured with non-ferrous metal or plastic fixings.
- F. The insulation on pipework concealed from view within buildings will not require further protective cladding.
- G. Insulation on pipework exposed to view and within plantrooms and external to the building shall be clad fully in a pre-formed aluminium stucco finish cladding 0.8 mm thick held in place by means of rivets or self tapping screws. All joints shall be sealed with a non-setting sealing compound. The Contractor shall take extreme care to ensure that the application of the metal cladding does not destroy the continuity of the vapour barrier.
- H. Valves, flanges and specialties shall be fitted with insulated removable boxes formed in 0.8mm thick aluminium stucco cladding.
- I. At all instrument points or tapings on pipework or ductwork the insulation shall be cut away and the edges neatly finished and sealed as for adjacent finishes allowing access for the instrument.

### 3.05 REFRIGERATION PIPEWORK INSULATION

- A. The suction line from the evaporator to the compressor shall be insulated with foamed plastic as specified previously and shall be protected by a vapour barrier which shall not be broken between joints of sectional material or at discontinuities of valves or brackets.

- B. Where possible the insulation shall be sleeved on the pipes before they are fitted. At all junctions, elbows, valves, and the like, it shall be carefully cut and fitted to the method recommended by the manufacturer.
- C. All open edges, joints and the like, shall be sealed with an adhesive as recommended by the insulation manufacturer.

### 3.06 PROTECTION

- A. The Contractor shall take all necessary measures to protect the works during construction. Any damaged sections of insulation shall be completely cut out and replaced with a new section. The vapour seal shall be repaired to ensure continuity.

All damaged sections shall be replaced at the Contractor's expense until the system is accepted and finally handed over.

**END OF SECTION 15291**



**SECTION 15310****FIRE PROTECTION PIPING****PART 1 GENERAL****1.01 SCOPE OF SECTION**

- A. This technical specification establishes the minimum requirements for the equipment to be incorporated into the infrastructure and above ground fire protection pipework.

**1.02 WORK INCLUDED**

- A. Provision of all labour, materials, and the performance of all operations necessary for the supply and installation of pipework, controls and equipment of the Fire Water Systems as specified herein and as detailed on the Drawings.
- B. Coordination: The Contractor shall ensure that the Fire Water Systems are fully compatible with all trades, particularly those of the Civil, Mechanical and Electrical services, for successful installation and operation.
- C. Submittals: The Contractor shall submit to the Engineer for review and approval, all calculations and drawings for the equipment proposed and associated builders works to show that the plant as installed will meet all the specified criteria.

No works shall commence on the production of the package or associated site works until the design has received the approval of the Engineer.

**1.03 QUALITY ASSURANCE**

- A. Manufacturers: The Contractor shall only propose the use of firms who have been regularly engaged in the manufacture of Fire Water Pumps and Equipment and whose product have proved satisfactory in similar service for not less than 10 years.
- B. Installer: Firms proposed for the installation of the Fire Water Pumps and Equipment shall have been regularly engaged for at least 5 years in the installation of plants of a similar type, quality and scope as is required for this project.

**1.04 APPLICABLE CODES AND STANDARDS**

- A. The Fire Water System shall comply with the latest relevant National Fire Protection Association (NFPA) codes and standards in all respects.
- B. The following are the most commonly used NFPA standards associated with Fire Water Systems. However, the Contractor shall ensure all applicable NFPA standards are complied with, whether here or not.

- NFPA 1 - Fire Prevention Code.
- NFPA 13 - Standard for the Installation of Sprinkler Systems
- NFPA 20 - Standard for the Installation of Centrifugal Fire Pumps
- NFPA 22 - Standard for Water Tanks for Private Fire Protection
- NFPA 24 - Standard for the Installation of Private Fire Services Mains and Their Appurtenances
- NFPA 26 - Recommended Practice for the Supervision of Valves Controlling Water Supplies for Fire Protection
- NFPA 31 - Standard for the Installation of Oil Burning Equipment
- NFPA 37 - Standard for Installation and Use of Stationary Combustion Engines and Gas Turbines
- NFPA 54 - National Fuel Gas Code
- NFPA 58 - Standard for the Storage and Handling of Liquefied Petroleum Gases
- NFPA 110 - Standard on Emergency Power Supplies
- NFPA 291 - Recommended Practice for Fire Flow Testing and Marking of Hydrants.
- ANSI B73.1 - Specification for Horizontal End Section Centrifugal Pumps
- FMEC - Loss Prevention Data 3-251. Break Tanks
- UL - Underwriters Laboratory

#### 1.05 SUBMITTALS

- A. Drawings - refer to Section 15010
- B. Products - submit full manufacturers data for every item.
- C. Provide samples of pipe work showing each type of joint to be used.
- D. Calculation.

#### 1.06 OPERATION MAINTENANCE DATA

- A. Comply with Section 15010.

#### 1.07 WARRANTY

- A. Provide 12 month warranty in accordance with contract conditions.

**PART 2 PRODUCTS****2.01 GENERAL**

- A. Pipework and fittings shall be as specified or approved equivalent and shall be manufactured fully in accordance with the relevant NFPA Codes and Standards and be UL listed.
- B. Pipework and fittings which have been subject to corrosion or damage shall not be acceptable.
- C. An underground system of pipework and valves shall be extended to hydrants and building fire fighting systems as indicated on the drawings.
- D. All goods and products shall be new and free from any surface rust or mill scale.
- E. All individual lengths of pipework or individual valves shall be stamped with their manufacturers name, place of origin, size and class of duty.
- F. All pipework and fittings (screwed and flanged) shall be suitable for the working pressure, operating temperatures and conditions of the fluids flowing within them. The declared pressure rating of the pipework shall be equal to or greater than the maximum test pressure of the system.
- G. The working pressure for pipework, connections and fittings is based on the total static pressure in the pipework in addition to the operating pressure exerted by the pumps on the system.

**2.02 ABOVE GROUND PIPING**

- A. Pipework for gas and arc welding shall be seamless black steel tube in accordance with NFPA 13 & 14 supplied with plain ends, bevelled for butt welding.
- B. All fittings for heavy weight steel tube shall be heavy weight weld fittings to NFPA 13 & 14.

Flanges for pipework shall be of the weld neck type. The use of slip on flanges will not be permitted.

Nuts, bolts and washers shall be of bright mild steel and the bolts shall be of the correct length and show a minimum of two threads after tightening.

- D. Pipework for screwing shall be seamless black steel tube to NFPA 13 & 14 supplied with screwed and socketed ends.
- E. Bends and swept tees shall be used throughout. The use of elbows will not be permitted and square tees will be allowed only where vent connections are taken off.

- F. Victaulic grooved mechanical pipe coupling, fitting, valves and other grooved components may be used as an alternative to welding, threading or flanged methods. All grooved components shall be from one manufacturer and shall be UL/FM listed. Grooved end product manufacturer shall be ISO 9001 certified. Pipe grooves shall be rolled in accordance with ANSI/AWWA standard C-606. Coupling shall be cast of ductile iron conforming to ASTM A536 Grade 65-45-12 or malleable iron conforming to ASTM A-47 Grade 32510. Jointing rings shall be grade "E" EPDM compound (green colour coded) conforming to ASTM D-2000 designation 2CA615A25B24F17Z. Temperature operating range -34 C to +110 C. Samples of pipe groove and couplings are to be submitted to the Engineer for approval.

### **PART 3 EXECUTION**

#### **3.01 INSPECTION OF FIRE SERVICES PIPEWORK**

- A. The Contractor shall inspect all products for damage immediately before installation. Any products that are damaged or not in accordance with this Specification shall immediately be repaired or removed from the site and replaced.

#### **3.02 HANDLING OF FIRE SERVICES PIPEWORK**

- A. All pipes, and piping accessories shall be inspected at time of delivery for damage and for compliance with this Specification.
- B. Any products that are damaged or found not to be in accordance with this Specification shall be immediately repaired or replaced. Such repairs shall be done only after the approval of the Engineer.
- C. All products shall be handled and stored as recommended by the manufacturer to prevent damage and deterioration.
- D. The Contractor shall supply handling equipment such as lifting beams, reinforced cranes are used, protective padding, struts, cradles, etc., required to install products without damage.
- E. The Contractor shall unload all products singly from trucks or lorries. Unless cranes are used, pipes shall be unloaded by means of skids and check ropes and no pipe shall be dropped.
- F. Each pipe unit shall be site stored, stacked and handled into its position in the trench only in such manner, and by such means, that affords total protection for it from damage of any kind. Site stacking of pipework shall be such that the pipework shall not deform or be damaged in any way through storage or retrieval. The manufacturer's recommendations shall be taken as the minimum requirements.

### 3.03 GENERAL INSTALLATION

- A. The runs of pipework indicated on the Drawings are as accurate as possible. They shall be taken as diagrammatic only and all pipework shall be installed in the neatest possible manner in the space available. Where this involves special fittings or settings of pipe they shall be provided by the Contractor, even though they are not indicated on the Drawings. Where possible pipework shall be run parallel to, or at right angles to the building walls.
- B. Where changes in direction are required and because of either lack of space or for neatness, fittings are not suitable, 'offsets' shall be installed as follows:-
- \* A 'Formed Bend', for a change in direction of less than 90 degrees.
  - \* A 'Single Offset', made up of two formed bends, returning the pipe to the same direction.
  - \* A 'Double Offset', made up of four formed bends, returning the pipe to the same direction and the same axis.

In all instances the offsets shall be 'Cold Drawn' and on no account shall heat be applied.

All sets, double sets and springs shall be formed on long lengths of tube with as large a radius as possible and all shall be free from distortion.

- C. All pipework shall be installed in such a manner as to ensure the automatic release of air and ease of drainage.

Any pipework fitted in an unsightly manner and not to the satisfaction of the Engineer shall be removed and re-fitted at the Contractor's own expense.

The Engineer shall have the right to inspect any pipe, pipe joint or pipe line fitting in order to check quality of materials and workmanship or system operation. Any defects shall be made good by the Contractor at his own expense and to the satisfaction of the Engineer.

- D. All pipes shall be at least 150mm from lighting and power cables or conduit unless otherwise specifically indicated on the Contract Drawings.

Pipes shall not be located above electrical equipment or in any other position where pipe leaks could cause liquids to come into contact with electrical equipment.

- E. Pipework shall be installed such that there is a minimum clear distance of 75mm to the finished floor level and a minimum clear distance of 25mm to the finished wall face from adjacent pipework services.

All pipework which is to be insulated shall allow space for each pipe to be insulated around its whole circumference. Adequate clearance shall be provided between insulated pipework running together and adjacent to walls and floors.

Clearances between insulation and floor and insulation and wall shall be as for bare pipework.

All pipework shall be installed such that they can be dismantled and are accessible for repair and replacement. Where valves and equipment are fitted, unions and flanges shall be provided as appropriate for the size of the pipework in order to allow removal of valves and equipment.

- F. No joints shall be formed in the thickness of walls, floor slabs or roof slabs. No pipework shall be chased into floor slabs, roof slabs or walls. During the installation period open ends of pipework shall be capped off using purpose-made plugs or blank counterflanges. Pipework shall be kept free of dirt and other foreign debris at all times.

All pipework buried in concrete or in accessible trenching shall be wrapped in 'Anti Corrosion Tape'. The tape shall be fixed strictly in accordance with the manufacturer's instructions.

- G. All pipework shall be arranged so that thermal expansion or contraction may be readily taken up by bends or changes in direction. Refer to Section 15512 Hydronic Expansion Compensation.
- H. All pipework shall be plumbed in the vertical and levelled to the turn of a bubble in the horizontal, except where wall of floor finishes deviate from the vertical or horizontal, in which case the pipework shall be parallel to the surface to present a neat appearance.
- J. All high points shall be provided with automatic air vents with weep lines piped to drain. Automatic air vents shall be connected to full bore "air bottle" connections from service pipe to ensure good air collection.

All low points shall be provided with valved drain connections. Where these occur in areas not having free access, the Contractor shall pipe the drain position to the nearest drain point, to be agreed with the Engineer.

- K. Due allowance shall be made for all necessary reducers, matching flanges, etc. to equipment, whether detailed or not.
- L. Where pipework crosses expansion joints in buildings, flexible couplings or axial compensators shall be employed in the pipework system to take account of both contraction and expansion of the pipework and the building structure. Axial compensators shall not be used on suspended pipework.

### 3.04 WELDED PIPEWORK

- A. Joints on all permanently concealed pipework and all pipework over 50mm size shall be welded. At dismantling points or where the pipework is connected to an appliance, ground-in spherical seated unions shall be used for pipework up to 50mm size and flanges shall be used for pipework 65mm size and above.

All flange joints shall be flush and truly aligned and shall employ klingerite joint rings coated on both sides with an approved jointing compound.

- B. All welding joints shall be made by oxy-acetylene or electric arc process strictly in accordance with BS 2640 and BS 2633 respectively and subsequent amendments. Welding shall be carried out in accordance with "Recommended Practice for Oxy-Acetylene Welds in Mild Steel Pipelines" issued by the Association of Heating, Ventilation and Domestic Engineering Employers, United Kingdom.
- C. All welded joints shall be executed by first-class certified welders working under skilled supervision. All craftsmen shall be experienced in this particular class of work for a period of not less than 12 months immediately preceding the commencement of the welding work called for in this Specification.

Each weld forming part of the installation shall be stamped by the welder responsible for the work with his own identifying die.

- D. During the welding process proper attention shall be given to correct alignment of pipe and fittings. The correct degree and duration of preheat shall be applied and the weld made with proper welding rod or electrode between properly prepared ends. Upon completion of the weld, the correct degree and duration of post-weld treatment shall be applied to ensure normalisation of the weld. All welds shall be of good clean metal, free from slag, of even thickness and contour, well fused with the parent metal, annealed and hammered upon completion and finished smooth prior to painting.
- E. No rusty pipework or fittings shall be used for welding prior to being thoroughly wire brushed.

"Flamecut" entries into pipework may be used, but cut edges shall be filed smooth and all swarf and cuttings removed from the bore of the pipe prior to the fitting being welded to the pipe. Square tee welds shall not be permitted. Long radius branch bend fittings shall be used for all sweep connections from mains in lieu of welding tees.

- F. The Engineer reserves the right to have up to 2% of all welds cut for his examination. The cutting of these selected welds and remaking shall be carried out at no extra cost. Should a test weld prove to be unsound and not in accordance with the Specification, the Engineer shall be entitled to cut further test pieces of work by the welder responsible for the fault. A maximum of 20% of this faulty welder's work may be cut out and remade at no extra cost. Should further welds prove to be unsound the Engineer reserves the right to instruct all welds made by the faulty welder to be cut out and remade at no extra cost. Should the Engineer's opinion be that the unsound/imperfectly made welds are due to faulty workmanship the Engineer shall have the right to insist on the suspension of the welder responsible.
- G. Should it be deemed necessary by the Engineer, radiographic inspection of welds may be requested. This radiographic examination shall be restricted to concealed pipework in trenches, voids, horizontal and vertical shafts and false

ceiling voids. Radiographic examination of welds shall be carried out in accordance with BS 2910 and the Contractor shall employ a specialist firm approved by the Engineer to carry out this work.

### 3.05 SCREWED PIPEWORK

- A. All pipework 50mm and below shall be screwed except where it is permanently concealed.

The threading of screwed joints shall be carefully made and shall be cut to produce an accurate thread free from burrs, snags and swarf. At least one of the engaging components shall be taper threaded. All ends of pipe shall be reamed to restore full bore prior to assembly. Subject to these provisions, threading may be carried out by hand or by automatic machine.

- B. Screwed joints shall be made using P.T.F.E. tape. Joints shall be pulled up tightly and all extruded jointing material shall be removed and the joint left clean.
- C. Where pipes are held in vices for threading, care shall be taken to ensure that the pipe surface is not damaged. Any pipework so damaged shall not be fitted.
- D. All pipework joints shall be cleaned thoroughly to remove traces of tape prior to painting with a final coat of red oxide.

### 3.06 PAINTING OF PIPEWORK AFTER INSTALLATION

- A. All ferrous surfaces to be wire brushed and painted with one coat of red oxide paint after installation.
- B. Refer to Division 9 for painting.

### 3.07 SYSTEM TESTING OF FIRE SERVICES PIPEWORK

- A. General:

1. The Contractor shall ensure that all pipework is watertight to the satisfaction of the Engineer and shall supply all pressure gauges, meters, hoses, pumps and all temporary supports, equipment and manpower necessary for carrying out pressure tests.
2. The Contractor shall, during testing, check the satisfactory operation of each valve and hydrant installed under the Contract.

- B. System Test:

1. Before filling or pressure testing is started the Contractor shall re-check pipes and valves for cleanliness and shall re-check the operation of valves. The open ends of the pipes shall normally be stopped off by blank flanges or capped ends additionally secured where necessary by temporary struts and wedges.



2. Fire water systems shall be suitable for the working pressure, operating temperatures and the conditions of the fluids flowing within them. the declared pressure rating of the pipework shall be equal to or greater than the maximum test pressure of the system. The testing shall be carried out in sections if necessary. If a section should fail the test, the Contractor shall trace and repair all leaks and defects and retest the section before any further pipes or section of adjacent pipework are laid.
3. The working pressure for pipework connections and fittings is based on the total static pressure in the pipework in addition to the operating pressure exerted by the pumps on the system.
4. The system shall be filled with potable water and all air expelled. After the system has been completely filled, the pressure shall be steadily and gradually increased until the test pressure has been reached. if any loss is recorded, repairs shall be made and the test re-run.

C. Test Results:

Written records of every test clearly identifying the tested section of the pipe together with time of test and name of testing engineer in tabulated format shall be submitted for review by the Engineer upon completion of the test.

### 3.08 FLUSHING AND DISINFECTION

- A. Fire services pipelines shall be flushed with potable water after completion of pressure testing and before disinfection.
- B. Liquid chlorine, calcium hypochlorite or sodium hypochlorite shall be used for disinfection. Where liquid chlorine is used, it shall be introduced only in conjunction with proper equipment and under the supervision of qualified personnel familiar with the physiological, chemical and physical properties of liquid chlorine and who are suitably trained and equipped for dealing with any emergency which may arise from its use.
- C. Fire service water from a suitable source shall be injected with flow control at a constant and measured rate. The water shall receive a dosage of chlorine fed at a measured constant rate to ensure chlorine concentration in the water entering the pipe is maintained at a minimum of 50mg/l. The chlorine residual shall be measured at regular intervals to ensure that the required chlorine concentration is maintained.
- D. During the application of chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall continue until the entire pipeline is filled with chlorine solution.
- E. After 24 hours retention, the heavily chlorinated water shall be flushed out with potable water, until the chlorine concentration in the water leaving the pipeline does not exceed 1 mg/l. Chlorine residual determination shall be made to ascertain that the heavily chlorinated water has been removed from the pipeline.

- F. Flushing water shall be discharged only to sites or into conduits. Discharges which cause damage, create nuisance or health hazard, or interfere with the work of others will not be permitted.

**END OF SECTION 15310**