



FIRE PROTECTION PIPING

PART 1 GENERAL

1.1 SCOPE OF SECTION

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

1.2 WORK INCLUDED

- A. Provision of all labor, materials, and the performance of all operations necessary for the supply and installation of pipe work, 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.

1.3 QUALITY ASSURANCE

- A. Manufacturers: The Contractor shall only propose the use of firms who have been regularly engaged in the manufacturer of Fire Water Pumps and Equipment and whose product have proved satisfactory in similar service for not less than 5 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.

1.4 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 14 - Standard for the Installation of Standpipe, Private Hydrant, and Hose 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

ANSI B73.1 - Specification for Horizontal End Section Centrifugal

Pumps FMEC - Loss Prevention Data 3-251. Break Tanks

UL - Underwriters Laboratory

FM - Factory Mutual

1.5 SUBMITTALS

A. Drawings

B. Products - submit full manufacturers data for every item.

C. Provide samples of pipe work showing each type of joint to be used.



- D. Full systems Calculations.

1.6 WARRANTY

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

PART 2 PRODUCTS

2.1 GENERAL

- A. Pipe work and fittings shall be as specified or approved equivalent and shall be manufactured fully in accordance with the relevant NFPA Codes and Standards .
- B. Pipe work and fittings that have been subject to corrosion or damage shall not be acceptable.
- C. An underground system of pipe work and valves shall be extended to 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 pipe work or individual valves shall be stamped with their manufacturers name, place of origin, size and class of duty.
- F. All pipe work 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 pipe work shall be equal to or greater than the maximum test pressure of the system.
- G. The working pressure for pipe work, connections and fittings is based on the total static pressure in the pipe work in addition to the operating pressure exerted by the pumps on the system. All Fittings and valves shall have 1.5 pressure rating of the system, taking into consideration pump close discharge pressure.

2.2 ABOVE GROUND PIPING

- A. Pipe work for gas and arc welding shall be seamless black steel schedule 40 tube in accordance with NFPA 13 & 14 supplied with plain ends, beveled for butt-welding.
- B. All fittings for heavy weight steel tube shall be heavy weight weld fittings to NFPA 13 & 14. Pressure rating of fittings and valves shall be as stated in point G above.



Flanges for pipe work 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. Pipe work for screwing shall be seamless black steel schedule 40 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

3.1 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.

3.2 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 pipe work shall be such that the pipe work shall not deform or be damaged in any way through storage or retrieval. The manufacturer's recommendations shall be taken as the minimum requirements.

3.3 GENERAL INSTALLATION

- A. The runs of pipe work indicated on the Drawings are as accurate as possible. They shall be taken as diagrammatic only and all pipe work 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 pipe work 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 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 counter flanges. Pipework shall be kept free of dirt and other foreign debris at all times.

All pipework buried in concrete or in accessible trenching or underground shall be wrapped in 'Denso Tape'. The tape shall be fixed strictly in accordance with the manufacturer's instructions. Buried pipes shall be painted by two layers of zinc rich anti corrosion paints before wrapping with "Denso tape".

- G. All pipework shall be plumbed in the vertical and leveled 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.



3.4 WELDED PIPEWORK

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

The welder responsible for the work with his own identifying die shall stamp each weld forming part of the installation.

- 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 pipe work or fittings shall be used for welding prior to being thoroughly wire brushed.

"Flamecut" entries into pipe work 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.

3.5 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.

3.6 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.

3.7 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:

Upon completion of the tests, 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 to the Engineer for review.

3.8 FLUSHING AND DISINFECTION

- A. Fire services pipelines shall be flushed with potable water after completion of pressure testing and before disinfections.



FIRE PROTECTION VALVES

PART 1 GENERAL

1.1 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 fire protection valves.

1.2 WORK INCLUDED

- A. The work includes the provision of all labor, materials and the performance of all operations in connection with the supply and installation of valves 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.

1.3 QUALITY ASSURANCE

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

1.4 APPLICABLE CODES AND STANDARDS

- A. The valves and all associated materials shall comply with NFPA Standards and be UL listed.

1.5 SUBMITTALS

- A. Drawings
- B. Products - submit full manufacturers data for every item.

1.6 WARRANTY

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



PART 2 PRODUCTS

2.1 GENERAL

- A. Bodies of valves and cocks on mild steel pipe work up to and including 50mm size shall be of cast gunmetal or bronze. Approved valves having hot-pressed bodies may be offered as an alternative. Bodies of valves 65mm size and larger shall be of cast iron. Castings and pressings shall be of good quality, clean and smooth and free from scale or flaws.
- B. Holes in covers or in gates for screwed portions of spindles shall have full threads of a length not less than the diameter of the spindle over the thread. Glands shall be machined to provide a running fit between the spindle and the stuffing box. Stuffing boxes shall be properly packed or fitted with "O" rings, which may be located in plastic bushes.
- C. Valves and cocks on mild steel pipe work up to and including 50mm size shall have taper screwed ends, and of 65mm size and above shall have flanged ends.
- D. All screwed valves shall have heavy hexagonal reinforcements at openings, threads of ample length to ensure sound joint and heavy shoulders to prevent over entry of pipes, fittings or adapters.

Flanged valves shall have flat-faced flanges.

- E. All valves and valve components (e.g. seating, packing, etc.) shall be suitable for the working pressures, operating temperatures and conditions of the fluid handled in the systems in which they will be installed. All valves shall be hydraulically tested to at least twice the working pressure of the systems in which they will be installed. Where necessary valves shall have extended spindles to facilitate insulation. The declared pressure rating of the valve shall be equal to or greater than the maximum test pressure of the system.
- F. The working pressure for valves is to be based on the static pressure in the pipe work in addition to the operating pressure exerted by the pumps on the system.
- G. Each valve shall have the manufacturer's name or trade mark, the UL and FM listed, the nominal diameters, the nominal pressure rating and body material all identified in the form of stamped or cast body markings.
- H. Victaulic grooved valves and fittings may be used as an alternative.

2.2 ISOLATING VALVES

- A. Isolating valves up to and including 50mm nominal bore shall be bronze or gunmetal gate valves with solid wedge discs, non-rising stems, screwed in



bonnets, metal hand wheels and screwed ends.

- B. Isolating valves for 65mm nominal bore and above shall be cast iron gate valves with solid wedge discs with bronze trim and seating, bolted on cast iron bonnets, high grade graphite asbestos free packing, rising stems with outside screws and yokes, cast iron hand wheels and flanged ends.
- C. Where shown on the drawings or specified herein, lock shield valves shall have easy-clean shields or enclosures to match the inlet valves. As a minimum requirement, one loose key shall be provided for every 25 N⁰ valves of the same spindle size.

2.3 NON-RETURN VALVES

- A. Non-return valves up to and including 50mm nominal bore shall be of the bronze swing pattern with screwed ends.
- B. Non-return valves 65mm nominal bore and above shall be of the cast iron swing pattern with bolted access covers, solid discs with bronze trim and seating ends. An air cock shall be fitted to the bolted cover for air release purposes.

2.4 DRAIN VALVES

- A. Drain valves shall be of the bronze straight type glanded pattern complete with brass hose union and malleable iron lever.

2.5 AIR COCKS

- A. Air cocks shall be nickel or chrome plated, of the spoutless pattern and with screwed tape thread. Two loose keys shall be provided for each installation having up to 10 air cocks and one loose key shall be provided for every additional ten air cocks.

2.6 AUTOMATIC AIR VENTS

- A. Automatic air vents shall be of bronze or gunmetal construction. Vents shall be designed to eliminate air from the system automatically without passage of water. The unit shall be of the float operated type screwed connection on the outlet to enable the unit to be piped to a remote drain position.

2.7 TEST & DRAIN VALVES

- A. All bronze, angle valve with screwed ends complete with metering orifice, discharge tundish etc.



2.8 ALARM CNTROL VALVE

- A. All bronze multi-port plug valve with screwed ends, operating lever and engraved position lever attached to body.

2.9 STRAINERS

- A. All bronze 'Y' type strainer with screwed ends, screwed cover and 30 mesh stainless steel screen for alarm supply line.

2.10 WATER MOTOR ALARM

- A. All bronze construction of through the wall type with threaded inlet and outlet connections, wall sleeve, drive shaft and bell.

PART 3 EXECUTION

3.1 STORAGE

- A. All valves shall be stored within a well lit container on purpose made compartmented racks or shelves, constructed in a similar manner to support the entire weight of materials without noticeable deformation.
- B. The valves shall be separated by means of their type and size and laid out in an orderly manner for ease of identification.
- C. Valves shall be supplied and stored with purpose made or manufactured plugs to prevent ingress of dirt.

3.2 GENERAL INSTALLATION

- A. Valves with screwed ends shall have a union installed adjacent to the valve for ease of dismantling.
- B. Where possible, valves shall be installed with the stem in the vertically upright position. However, all valves shall be installed in a manner such that they are readily accessible for ease of operation.
- C. Sufficient clearance shall be allowed for the application of thermal insulation, valve boxes, etc. and to ensure that full travel of the valve stem can be achieved.

3.3 ISOLATING VALVES

- A. Separate isolating valves shall be provided on all pipe work services to each item of plant or equipment and on each main and sub main, except where flow



measuring or regulating valves are required and these valves can be used for isolating purposes without affecting their measuring or regulating functions.

3.4 DRAIN VALVES

- A. Drain valves shall be installed at all system low points on the dead side of isolating valves and on all items of plant to facilitate emptying down and removal.
- B. Line sized drain valves shall be installed at the end of each pipe work run and at the base of each pipe work riser to enable the system to be adequately flushed.

3.5 AIR VENTING DEVICES

- A. Air venting devices shall be installed at all system high points.
- B. Automatic air eliminators shall be complete with galvanized mild steel relief pipe work, taken to within 1.5 m of the floor level with a gunmetal isolating valve and extended to a position where any discharge will not damage building fabrics, decorations or the like.
- C. Air bottles shall be made from 50mm size tube. Each shall be a minimum of 150mm long, fitted with a cap and 8mm size air cock. Where an air bottle is fixed out of reach, a 15mm extension tube shall be run from the cap to within 1.5m of the floor level and terminating with a needle valve and hose union.

3.6 RETARD CHAMBERS

All controlling valves, alarms and indicator switches shall have retard chambers adjustable from 0-90 seconds to avoid false alarms.

All O.S.&Y valves shall be fitted with supervisory switches wired back to central fire indicator panel and BMS to signal alarm if valves are tampered with



SUPPORTS, HANGERS AND BRACKETS PART 1

GENERAL

1.1 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 Supports, Hangers and Brackets.

1.2 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 Supports, Hangers and Brackets 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.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the manufacture of Supports, Hangers and Brackets 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 installation of pipework systems with at least 5 years successful installation experience on projects of a similar nature.

1.4 APPLICABLE CODES AND STANDARDS

- A. The Supports, Hangers and Brackets and all associated materials and workmanship shall comply with the latest NFPA, ASHRAE and SMACNA requirements.

1.5 SUBMITTALS

- A. Drawings
- B. Products - Submit full manufacturers data for every item.

1.6 OPERATION AND MAINTENANCE DATA

- A. Comply with Section 15010.



1.7 WARRANTY

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

PART 2 PRODUCT

2.1 GENERAL

- A. All supports, hangers and brackets shall be of an approved manufacture and shall conform to the requirements of NFPA 13 and NFPA 14. All hangers and supports of fire protection network shall be of the seismic type. Calculation of loading along with support and hanger selection, and shop drawing shall be submitted to Engineer for approval.
- B. All steel products used for support systems if not manufactured from malleable cast iron or stainless steel shall be either galvanized or painted with one coat of red oxide paint.
- C. All drop rods shall be galvanized and sized to suit the bracket type and system weight but in no case shall be less than 6 mm diameter.
- D. All materials used for support systems shall be compatible with the material they are supporting. Generally all steel pipework shall be supported by cast iron and steel clips while UPVC pipework shall be supported by brass or PVC clips. Where galvanized steel pipework is used all pipework clips shall be galvanized.
- E. Where brackets are exposed to view they shall be of a chrome plated finish.
- F. Fixings to concrete and masonry shall be of the expanding bolt or wedge anchor type selected in accordance with the manufacturers recommendations and suitable for the imposed loads. Where fixings are to be made close to the outside edge of concrete or masonry structures resin banded fixings shall be used to reduce the risk of fracture.
- G. Brackets for fixing to woodwork or light weight partitioned walls shall be of the screw on pattern.
- H. Purpose made girder clamps shall be used where any system is supported from steelwork and only with the approval of the Engineer.



PART 3 EXECUTION

3.1 STORAGE

- A. All continuous lengths of channel angle and screwed rod shall be stored on purpose made pipe racks of welded construction and of sufficient strength to support the entire weight of the material without any noticeable deformation. The racks shall be such that all material is clear of the ground.
- B. All raw metal shall be wire brushed and painted with one coat of red oxide paint prior to storage.
- C. All general support materials shall be stored within a well lit container on purpose made compartmented racks or shelving. The materials shall be separated by means of their type and size and laid out in an orderly manner for ease of identification.

3.2 GENERAL

- A. All systems shall be adequately supported in such a manner as to permit free movement due to expansion, contraction, vibration or other changes in the system. Supports shall be arranged as near as possible to joints and changes in direction.
- B. Vertical rising pipes and ducts particularly in shafts shall be adequately supported at the base to withstand the total weight of the riser. Under no circumstances shall branches from vertical rising pipes be the means of support for the vertical pipework.
- C. Hangers for horizontal systems at high level shall be supported from angle or channel irons suitable for securing to the structure.
- D. Pipework shall be independently supported, double stacking of pipes from the same support will not be permitted.
- E. Adjustable mild steel hangers on steel pipework systems shall be used with swivel joints at the pipe rings and spherical washers at the top of the hanger rods. Pipe rings shall be malleable cast iron or fabricated steel made in halves and secured by bolts or screws. Malleable iron hinged pipe rings may also be used but caliper hooks shall not be permitted. Pipework 65 mm diameter and over shall not be supported using malleable iron brackets. All pipe brackets over 50 mm diameter shall be submitted to the Engineer and approved by the Engineer prior to manufacture.
- F. Where rollers and chairs are required, these shall be preformed and where used singularly they shall have restraining "U" straps or bolts formed over the diameter of the pipe and bolted to the base support of the chair. The "U" straps or bolts shall be fitted to allow movement of the pipe without binding. Continuously threaded "U" bolts will not be permitted.



- G. The spacing of supports shall be determined in accordance with the following table. Where one support carries more than one pipe of different diameters the spacing shall be determined by the requirement of the smallest diameter.

Figures are for normal ambient temperatures below 20°C. For temperatures above 20°C the pipe manufacturer should be consulted. Based on average temperature of 80°C.

Maximum spacing of fixings for internal piping shall conform to the requirements of NFPA 13 and NFPA 14.



FIRE PROTECTION SYSTEMS AND EQUIPMENT

PART 1 GENERAL

1.1 SCOPE OF SECTION

- A. This technical Specification establishes the quality of materials and workmanship to be used in the supply and installation of the Fire Protection systems and equipment used internally within buildings.

1.2 WORK INCLUDED

- A. Provisions of all labour, materials and the performance of all operations in connection with the installation and testing fire protection and fire fighting systems within buildings as specified herein and shown on the drawings.
- B. Coordination: The Contractor shall be responsible for proper coordination of the work of all trades and shall provide clear drawings where necessary.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the manufacture of fire fighting and fire protection systems and equipment fittings whose products have been in satisfactory use in similar service for not less than 10 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with fire fighting and fire protection schemes and equipment similar to that required for this project.

1.4 APPLICABLE CODES AND STANDARDS

- A. The Fire Protection systems and equipment shall comply fully with the latest relevant National Fire Protection Association standards in all respects.
- B. The following are the most commonly used NFPA Standards associated with Fire Protection systems. However, the contractor shall ensure that all applicable NFPA Standards are complied with, whether listed here or not.

NFPA 1 - Fire Prevention Code.

NFPA 10 - Standard for Portable Fire Extinguishers.

NFPA 13A - Recommended Practice for the Inspection, Testing and



Maintenance of Sprinkler Systems.

- NFPA 13E - Recommendations for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems.
- NFPA 14 - Standard for installation of Standpipe and Hose Systems.
- NFPA 17 - Standard for Dry Chemical Extinguishing Systems.
- NFPA 20 - Standard for The Installation of Stationary Pumps for Fire Protection
- NFPA 72 - Standard for Installation, Maintenance and Use of Local Protective Signalling System for Guard's Tour, Fire Alarm and Supervisory Service.
- NFPA 78 - Lightning Protection code.
- NFPA 79 - Electrical Standard for Industrial Machinery.
- NFPA 1961 - Standard for Fire Hose.
- NFPA 1962 - Standard for the Care, Use and Maintenance of Fire Hose including Connections and Nozzles.
- NFPA 1963 - Standard for Screw Threads and Gaskets for Fire Hose Connections.
- NFPA 2001 - Clean agent extinguishment systems.

1.05 SUBMITTAL

- A. Drawings
- B. Products - submit full manufacturers data for every item.

1.6 WARRANTY

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

PART 2 PRODUCTS

2.1 GENERAL DESCRIPTION

- A. All materials, equipment and procedures associated with the Fire Protection Systems shall be in accordance with NFPA requirements.
- B. Where operating or warning instructions are provided or specified they shall be



clearly denoted in Arabic and English.

- C. The Contractor shall supply original authenticated certificates for each type of material or equipment, confirming the standard they have been manufactured and tested to.

2.2 HOSE REEL CABINET

The cabinet and door leaf shall be made of 1.5 mm steel sheet with all around folded edges, door leafs hinged flush mounted or doorframe. The cabinet shall be painted red with electrostatic powder paint. The cabinet shall be complete with the water connections placed to suit the supply pipes. The door shall be recessed type with aluminum turn handle chrome plated. The cabinet shall consist of A Hose reel.

2.3 SIAMESE CONNECTION ASSEMBLY

- A. Siamese connection assembly shall be installed for use of fire brigade as shown on the drawings.
- B. The Siamese connection assembly shall be bronze with two inlets. Each inlet shall consist of a 65 mm instantaneous male coupling and a non-return valve an protected with a cap secured by a suitable length of chain.
- C. The Siamese connection shall be according to NFPA 24 and UL listed and FM approved
- D. The assembly shall include 2-way inlet breeching; drain valve, concrete support and other details. The Siamese connection assembly connection assembly mounted horizontally

shall be installed in steel cabinet with glazed door. Horizontal inlet box with door fitted with Georgian wired glass panel marked "wet riser inlet" or "dry riser inlet" according to the drawings and spring cylinder lock with key.

- E. The Siamese connection assembly shall have 100 mm flanged outlet for attachment to the dry or wet main.
- F. The assembly shall be finished with red color paint.

2.4 SPRINKLERS

- A. Sprinklers shall be installed as shown on drawings and in accordance with the requirements of NFPA 13.
- B. All Sprinklers shall be manufactured, tested and approved in accordance with the applicable standards of Underwriter Laboratories and Factory Mutual.
- C. Automatic sprinklers shall have a temperature rating as shown on drawings. Orifice diameter shall be 15 mm with NPT thread type.



2.5 ALARM VALVE ASSEMBLY

- A. Alarm valve assembly shall be UL listed FM approved
- B. Alarm floor control valve shall comprise : indicating OS&Y gate valve equipped with tamper switch, test connection, drainage outlets and tundish, pressure gauge water flow switch.
- C. Alarm valve assembly shall comprise: control check valve, indicating OS&Y gate
- D. Valve equipped with tamper switch, water flow switch, test connection, pressure gauge and drainage outlet with tundish.
- E. Water flow switch shall be UL listed FM approved, and constructed and installed in a manner that any flow of water from sprinkler system equal or greater than from a single automatic sprinkler will actuate the alarm system. Water flow switch including alarm circuits shall be tested by an actual water flow through use of the test connection.
- F. Tamper switch provided for the indicating gate valve shall initiate an alarm when the indicating valve is moved from the normal position. A test connection not less than 50 mm diameter, terminating in a smooth bore corrosion resistant orifice to provide a flow equivalent to one sprinkler flow, shall be installed and equipped with sight glass, drain valve and shut off valve.

2.6 PORTABLE FIRE EXTINGUISHERS

- A. Portable Fire Extinguishers shall be of the type indicated on the drawings and specified herein.
- B. The fire extinguishers shall conform to the requirements of NFPA 10 for design standard and performance with the classes of fire as defined in that standard and this Specification.
- C. Classes
 - Class A Fire involving solid materials, usually of an organic nature such as wood, cloth, paper, rubber and many plastics.
 - Class B Fires involving flammable liquids, oils, greases, tars, oil based paints, lacquers and flammable gases.
 - Class C Fires involving energized electrical equipment where the electrical non-conductivity of the extinguishing media is of importance.
- D. Multi-purpose dry powder (chemical)-Class A.B. and C fires. Multi-purpose dry powder extinguishers shall be ammonium phosphate, stored pressure type with steel cylinders, braided PVC or black reinforced rubber discharge hose and nozzle and pressure gauge. Suitable carrying handles shall be incorporated in the extinguisher body or the control mechanism moulding. Extinguishers shall be hermetically sealed to prevent moisture contaminating the powder.



E. Special Features

All portable extinguishers shall be wall bracket mounted as shown on the drawings. Wall mounted units shall be supplied complete with purpose made wall brackets, and the Contractor will secure these to the building structure so that the installed height of each extinguisher conforms to the NFPA Standard 10 Clause 1-6.9 relative to its gross weight. Where floor standing units are provided these shall be fitted with integral steel skirts such that the extinguisher body itself does not rest on the floor. Specific extinguisher requirements are shown on the drawings. Where concealed mounting is required the extinguisher shall be provided with all accessories required for such mounting.

All types of extinguisher shall be fitted with a locking pin arrangement to prevent accidental discharges, the safety pins being secured to the unit by a chain or wire cable to prevent loss.

F. Design, Deployment and Capacity

The extinguisher designs shall be such as to facilitate inspection, cleaning, repair and replacement, and be simple and reliable when in use under operational (or training) conditions.

The mounting requirement for extinguishers shall be as shown on the Drawings. The Contractor shall not deviate from this requirement or other aspect of the specification without the permission of the Engineer.

The locations, type of extinguishing and capacity of fire extinguishers are shown on the relevant Drawings. The capacity of each unit specified is the minimum quantity of extinguishing required at the location indicated. The Contractor may supply slightly larger sizes to that specified where the Specification does not coincide with a particular supplier's production standard extinguisher. If the nearest standard deviates considerably from the Specification the Contractor shall obtain the approval of the Engineer before placing his order.

G. Extinguisher Marking

All extinguishers shall carry in English and Arabic clear and concise operating instructions and warnings against use on fires for which the extinguishant is not suitable, or any other warnings of which the operator must take heed. The extinguisher class suitability and warnings may take the form of pictorial labels as depicted in the NFPA Standard 10.

The following information shall also be clearly marked on the body of each unit:

1. The name of the manufacturer.
2. Instructions for regular periodic checking of the units for operational serviceability.



PART 3 EXECUTION

3.1 STORAGE

- A. All pipework shall be stored on purpose made racks of welded construction and of adequate strength to support the entire weight of materials without noticeable deformation.
- B. All pipework shall be stored clear of the ground and with all open ends sealed with purpose made or manufactured plugs to prevent the ingress of dirt.
- C. All fittings shall be stored within a well lit container on compartmented racks or shelving, separated by their type and size and laid out in an orderly manner for ease of identification.
- D. Hose reels, fire extinguishers and fire blankets shall be covered in protective packaging and stored in a well lit container. Fire extinguishers in particular, shall be secured to prevent damage resulting from falling and in no instance shall they be subject to temperatures in excess of 50°C for to direct sunlight.

3.2 GENERAL INSTALLATION

- A. All items shall be installed in the locations indicated on the drawings and strictly in accordance with the manufacturer's instructions.
- B. The installation shall comply fully with all applicable standards and codes listed in Part 1.04.
- C. Pipework shall be installed in accordance with relevant standards.
- D. Hose reels, fire extinguishers and fire blankets shall be securely fixed with approved fixings in a position offering unobstructed access.



TANKS

PART 1 GENERAL

1.1 SCOPE OF SECTION

- A. The work described in this section covers the support, installation and quality of materials and workmanship for the potable water storage tank installation.

1.2 QUALITY ASSURANCE

- A. Material and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of products that have been in satisfactory use for a period of ten years.
- B. Installer firms proposed for the installation of the storage tanks and equipment shall have been engaged for at least 5 years in the installation of tanks of a similar type, quality and scope as is required for this project.

1.3 WORK INCLUDED

- A. Provision of all labour, materials, and the performance of all operations necessary for the supply and installation of potable water storage tank and equipment of the as specified herein and as detailed on the Drawings.
- B. Coordination: The Contractor shall ensure that the storage tanks 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.

PART 2 PRODUCTS

2.1 GENERAL

- A. For number site and location of tanks refer to drawings and bills of quantities. Tanks shall be Vertical multilayer Polyethylene tanks.



- D. In accordance with the sites shown on the drawings each tank shall be provided with connections for the following:
- | | |
|--------------|--------------------------------|
| Water inlet | Vent pipe (with insect screen) |
| Water outlet | Drain |
| Access cover | Overflow |
| Float valves | |

PART 3 EXECUTION

3.1 INSTALLATION OF TANKS

- A. Storage tanks to be installed in strict accordance with recommendations.

3.2 INSPECTION OF TANKS AND TESTING

- A. Storage tanks: slowly fill with water to top water level and visually inspect for leaks.



AIR MOVERS: CENTRIFUGAL AND AXIAL

PART 1 GENERAL

1.1 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 Air movers.

1.2 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 Air movers as specified herein and where referred to on the Drawings, and schedules.
- B. Coordination: The Contractor shall be responsible for the full coordination of the work of all trades.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the manufacture of Air movers 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 installation of Air movers with at least 5 years successful installation experience on projects of a similar nature.

1.4 APPLICABLE CODES AND STANDARDS

- A. The Air movers and all associated materials and workmanship shall comply fully with the latest relevant American, British and International Standards in all respects.

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

BS: 848 - Fans for general purposes.

BS: 4675 - Mechanical vibration in rotating machinery.



BS: 5285 - Specification. Performance of a.c. electric ventilating fans and regulators for non-industrial use.

1.5 SUBMITTALS

- A. Drawings
- B. Calculations - submit fan head calculations based on Contractors working drawings.
- C. Products - submit full manufacturers data for every unit and component.

1.6 WARRANTY

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

1.7 EXTRA MATERIALS

- A. Supply one spare set of drive belts for each fan.

PART 2 PRODUCTS

2.1 GENERAL

- A. Values of the resistance to airflow of items of equipment, ductwork and/or the total distribution system indicated in the contract documents are approximate. It shall be the responsibility of the Contractor to verify these values based on the equipment offered and provide fans capable of delivering the required air volume when operating against the actual total system resistance. Fans shall be tested in accordance with the requirements of BS848 and shall be selected to give the air volume flow rate and sound power level specified in the contract document.
- B. All fans shall be constructed to a fully developed design and shall be capable of withstanding the pressures and stresses developed during continuous operation at the selected duty. Additionally, all belt driven fans shall be capable of running continuously at 20 percent in excess of the selected duty speed. Fan and motor assemblies shall be selected to allow a 10 percent increase in fan duty by a change of belts and pulleys only. External pressure shall increase with the "square-law", and shall be overcome.
- C. Fans shall be installed using bolts, nuts and washers with all "as cast" bearing surfaces for bolt heads and washers counter faced. Holding-down bolts for fans and motors shall be provided with means to prevent the bolts turning when nuts tightened. Anti-vibration mountings shall be provided. Fans heavier than 20 Kg. shall be provided with eyebolts or other purpose made lifting facilities.

- D. The shaft and impeller assembly of all centrifugal, axial flow and mixed flow fans shall be statically and dynamically balance. All propeller fans shall be statically and dynamically balanced where the impeller diameter is 750mm or greater. Where indicated, limits of vibration severity shall be in accordance with BS 4675 Part 1.
- E. Fan bearings shall be of air handling, heavy duty, grease lubricated, selected for a basic rating life L10 of 100,000 hours at maximum speed and horsepower. The bearing type shall be suitable for the installed attitude of the fan. They shall be grease/oil ball and/or roller type or alternatively oil lubricated sleeve type.
- F. All bearing housings shall be precision located in position and arranged so that bearings may be replaced without the need for realignment. Bearing housings shall be protected against the ingress of dust and, where fitted with greasing points, they shall be designed to prevent damage from over-greasing. For grease lubricated systems, the bearings shall be provided with grease in amount and quality recommended by the bearing manufacturer. For oil lubricated systems, the housings shall provide an adequate reservoir of oil and shall include a filling plug and be oil tight and dust proof. Systems other than total loss types shall include an accessible drain plug. All bearing lubricators shall be located to facilitate maintenance.
- G. Where fans are required to handle toxic, corrosive, moisture laden, flammable, explosive or high temperature gases the materials of construction shall be selected to ensure suitability and all relevant safety regulations shall apply. Bearings and lubrication arrangements shall be suitable for the prevailing conditions. Where a protective coating is required for use with corrosive gases, the coating shall cover all parts of the complete fan, motor and casing assembly which are in contact with the corrosive gases. No fan shall be installed if the protective coating has been damaged in any way. Impellers shall be of coated steel, stainless steel or aluminum or plastics as indicated.
- H. Motors shall be totally enclosed, suitable for 380 volts, 3-phase, 50 Hertz electrical supply or 220 V single phase, 50 Hertz electrical supply as indicated on the drawings. Motors for general use shall be provided with Class F insulation as a minimum standard and be suitable for running continuously in ambient temperatures of 50°C. Smoke handling fans shall have temperature ratings as specified.

2.2 CENTRIFUGAL FANS

- A. Centrifugal fans for high and medium velocity systems (defined within HVAC specification DW 143) shall be backward bladed type.
- B. Fan casings shall be constructed to permit withdrawal of the fan impeller after fan installation. Fans other than those in the air handling units shall be provided



with flanged outlet connections and spigoted inlet connections unless otherwise indicated, except that for negative pressures greater than 500 Pa, inlet connections shall be flanged.

- C. A plugged drain point shall be fitted at the lowest point in fan casings.
- D. Permanent indication shall be provided to show the correct direction of rotation of the fan impeller. Fan casings shall be provided with removable access panels which shall incorporate purpose made air seals. The sizes of access panels shall be such as to facilitate cleaning and maintenance of the impeller. Impellers shall be of mild steel or aluminium alloy of riveted, welded or other approved construction, with spiders or hubs of robust design.

2.3 AXIAL FLOW FANS

- A. Axial flow fan casings shall be rigidly constructed of mild steel or aluminum alloy, stiffened and braced where necessary to obviate drumming and vibration. Mounting feet shall be provided where necessary for bolting to a base or to supports. Inlet and outlet ducts shall terminate in flanges to facilitate removal. For in-duct mounting fans, the length of the fan casing shall be greater than the combined length of the impeller(s) and motor(s) and electrical connections to the motors shall be through an external terminal box secured to the casing.
- B. Impellers shall be of steel, aluminum or plastics and the blades shall be secured to the hub, or the blades and the hub shall be formed in piece. The hub shall be keyed to the shaft. Blades shall be aerofoil section or laminar and capable of pitch adjustment where indicated.
- C. Axial flow fans shall be complete with spring anti-vibration mountings and revertex type flexible inlet and outlet ductwork connections. Inlet and outlet cones shall be supplied where free air inlets or outlets are indicated on the drawings and shall be protected using galvanized wire mesh guards, 1.2mm diameter wire with 25mm mesh.
- D. Where axial flow fans are driven by motors external to the casings of the fans, drive guards shall be provided. Unless otherwise indicated, a guard is not required for any part of a drive which is inside the fan casing. An access panel with purpose made air seal shall be provided in the fan casing. The access panel shall be sized to facilitate maintenance.

2.4 BIFURCATED AXIAL FLOW FANS

- A. Bifurcated axial flow fan casings shall be rigidly constructed of mild steel or aluminum alloy, stiffened and braced where necessary to obviate drumming and vibration. Mounting feet shall be provided where necessary for bolting to a base or to supports. Inlet and outlets ducts shall terminate in flanges to facilitate removal. For in-duct mounting of fans the length of the fan casing shall be greater than the combined



length of the impeller(s) and motor(s) and electrical connections to the motors shall be through an external terminal box secured to the casing.

- B. Impellers shall be fixed pitch cast iron and shall be secured to the hub. The hub shall be formed in one piece and be keyed to the shaft.
- C. Bifurcated axial flow fans shall come with spring anti-vibration mountings and revertex type flexible inlet and outlet ductwork connections. Inlet and outlet cones shall be supplied where free air inlet or outlets are indicated on the drawings and shall be protected using galvanized wire mesh guards, 1.2mm diameter wire with 25mm mesh.
- D. Bifurcated axial flow fans shall be driven by motors contained within a separate casing within the main fan casing. The motor shall be completely separated from the air stream and shall be of the totally enclosed squirrel cage induction type, fitted with ball bearings.

PART 3 EXECUTION

3.1 STORAGE

- A. Fans shall be stored in a well lit containers, covered to prevent ingress of dirt and clearly marked with location for ease of identification.
- B. Small fans shall be stored on shelving in a manner that will minimize the risk of damage.

3.2 INSTALLATION

- A. All fans shall be installed in accordance with the manufacturers' instructions and in the locations shown on the drawings.
- B. In-line fans shall be supported independently of the ductwork system.
- C. All transit packaging shall be removed from fan/motor assemblies at the installation stage.
- D. Roof mounted fans shall be mounted on purpose made curbs and fully weathered.



DUCTWORK

PART 1 GENERAL

1.1 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 Metal Ductwork.

1.2 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 metal ductwork 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.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the factory fabrication of Metal Ductwork whose products have been in satisfactory use in a similar application for not less than 5 years.
- B. Installer: Firms regularly engaged and qualified in the installation of Metal Ductwork with at least 5 years successful installation experience on projects of a similar nature.

1.4 APPLICABLE CODES AND STANDARDS

- A. The Metal Ductwork and all associated materials and workmanship shall comply fully with the latest relevant standards in all respects.
- B. The following are the most commonly used and relevant British, American and other Standards for Metal Ductwork and associated materials. However, the Contractor shall ensure that all applicable standards are complied with whether listed here or not.
 - 1. Specification for sheet metal ductwork No. DW 143 and Addendum "A" 1988 for low, medium and high pressure / velocity air systems published by heating, ventilating contractors association (HVCA) UK.
 - 2. The SMACNA (Sheet Metal and Air Conditioning Contractors' National Association, Inc.) duct manual and sheet metal construction for ventilating and air conditioning systems
 - 3. Low Pressure Duct Construction Standards, 5th ed. (SMACNA).
 - 4. Rectangular Industrial Duct Construction Standards. (SMACNA)
 - 5. The ASHRAE handbook published by the American Society of Heating,



- Refrigerating and Air Conditioning Engineers Inc. - Duct Construction
- 6. ASTM Standard A525 : Hot Dipped Galvanized Steel Sheets
- 7. Standard for the Installation of Air Conditioning and Ventilating Systems (National Fire Protection Association, ANSI/NFPA 90A-93).
- 8. Standard for the Installation of Air Conditioning and Ventilating Systems (National Fire Protection Association, ANSI/NFPA 90A-93).
- 9. Standard for the Installation of Warm Air Heating and Air Conditioning Systems (National Fire Protection Association, ANSI/NFPA 90B-93).

1.5 SUBMITTALS

- A. Drawings
- B. Calculations
Fan head calculations shall be submitted to the engineer for approval based on Contractor ductwork working drawings.
- C. Products - Typical duct section and fittings to demonstrate integrity of construction.
- D. Full details of air test procedures.

1.6 WARRANTY

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

PART 2 PRODUCTS

2.1 GENERAL

- A. All figure numbers referred to throughout this ductwork specification relate to those contained in DW 143. Equivalent figures to SMACNA will be accepted.

Ductwork for general exhaust shall be galvanized steel G90. Ductwork for local incinerator exhaust system shall be welded black steel as per drawings. Outer and inner surfaces of the black steel duct shall be painted with two layers of antirust heat resistant fire retardant paint with external surface final paint layer, color to be decided by the client.

- C. Ductwork shall be manufactured to the sizes detailed on the drawings
- D. The interior surfaces of all ductwork shall be smooth. No sheet metal parts, tabs, angles, or similar shall project into the air stream for any reason unless specified to



do so. All seams and joints shall be external.

- E. The minimum nominal sheet thickness for any ductwork shall be 0.8 mm for internal systems with the longer duct size up to 1000mm. Where the longer duct size exceeds 1000 mm the nominal sheet thickness shall be 1.0 mm.
- F. The Contractor shall ensure that the choice of gauge thickness for ductwork and the stiffening provision is such that the ductwork installation does not drum or vibrate. Single stiffeners shall be used as illustrated in figures 44-49 inclusive of DW 143 or SMACNA equivalent.
- H. All jointing and construction methods shall be approved by the Engineer.
- I. Approved sealant shall be used on all ductwork longitudinal seams. The sealant can be included in the seam during manufacture and applied as an edge sealant.
- J. Button punch snap lock longitudinal joints shall not be used.
- K. Particular attention shall be given to ensuring that cross jointing methods are suitable for the specified pressure rating. Cross joints shall generally be flanged and corner treatment shall be such that corners pull-up true and square and do not leak. An approved liquid or mastic sealant shall be used on all cross joints.
- L. Change shapes that maintain the cross sectional area shall have sides where the slope does not exceed 22.5° on any side. Should it be necessary to reduce the cross sectional area the slope shall not exceed 15° on any side and the reduction in area shall not exceed 20%. In this instance the approval of the Engineer shall be sought prior to manufacture.
- M. The slope of expansions and contractions shall not exceed 22.5° on any side unless it is unavoidable, in which case splitters shall be provided to bisect the angle between the sloping side and the centre line of the duct.
- N. Ductwork connections to plant and equipment (eg. cooling and heating coils,) shall, in the case of bolted flanges, be provided with matching flanges of similar size and thickness. Sheet metal returned flanges shall not be permitted.
- R. The ductwork sizes indicated on the drawings are nominal, therefore for socket and spigot joints the actual dimensions of ductwork and fittings shall be correctly related so that when installed the joint shall be effectively sealed.
- S. Bends shall be either segmented with swaged ends, or in the case of ductwork 400mm diameter and below, pressed bends of the long radiuses type shall be acceptable.



- T. Tapers of the concentric type shall be manufactured with an angle not exceeding 15°. Tapers of the eccentric type shall have angles not exceeding 30°.
 - V. Hangers and supports for ductwork systems shall generally comply with DW 142
- Part 6. Primary fixings into the building structure shall be subject to approval by the Engineer.
- U. Ductwork hangers and supports shall be adjustable for height, spaced to ensure adequate support and where practicable, fitted at each ductwork joint or spaced at not more than the maximum centres in Tables 24, 25 and 26 for rectangular, circular and flat oval horizontal ducting. Securing of formed brackets to corners of ductwork as a means of suspension shall not be permitted.
 - V. Supports for vertical ductwork in facility shall be generally located at to a maximum spacing of 2.5 meters. Special care to be considered for local incinerator exhaust air duct support. U channel (supported from floor and ceiling slab) to be used to support vertical ducting
 - W. All ductwork shall be securely supported from the building structure but inert packing material shall be provided between ducts and supports to prevent direct contact of the ducting with the structure.
 - XI. All outdoor duct work shall be surface treated with proper painting materials to prevent galvanized steel from corrosive ambient

PART 3 EXECUTION

3.1 STORAGE

- A. Ductwork shall be either stored on purpose made racks of welded construction, or in a dry open area stored clear of the ground.
- B. All open ends of ductwork shall be sealed with polythene sheeting to prevent the ingress of dirt.
- C. Small ductwork sections shall not be stored within larger sections except in the case of circular ducts.
- D. Ductwork shall not be stacked in a manner that will result in damage to or deform of the sections will occur.
- E. All ductwork shall be stored with an identification label indicating the piece number,



size and location in which it is to be installed.

3.2 FIXINGS

- A. Mechanically closed rivets shall be used strictly in accordance with the manufacturers recommendations with regard to use, size and clearance drill size.
- B. Bolts, nuts and washers shall be used for flanged sections of ductwork and shall be of mild steel protected by electro galvanizing, cadmium plating or a similar approved finish.
- C. Self tapping screws shall be used subject to the approval of the Engineer, in instances where other types of fixing is not practical.
- D. Welding shall not be permitted on galvanized sheet steel materials.

3.3 GENERAL INSTALLATION

- A. Ductwork shall be installed generally as indicated on the drawings and details subject to full coordination and fully in accordance with the HVCA DW 143 or SMACNA manuals referred to in Part 2.0.
- B. Where sets and final plant connections are required site measurements shall be taken to establish dimensions prior to manufacture.
- C. All ductwork joints shall be fitted with the recommended minimum number of fixings, cleats or clamps. Sealants shall be used at all joints.
- D. Branches shall be installed off straight sections of ductwork and not off taper sections.
- E. Particular regard must be paid to the prevention of duct movement, with consequent noise, potential leakage and strain upon flexible connections.
- J. Care shall be exercised to ensure that no edges protrude into the airways, and that all spigots (especially on high velocity systems) are well matched so that a smooth airflow is achieved throughout the length of the ducting. Any section of ductwork causing noise due to poor construction shall be removed and reinstated at the Contractor's expense.
- K. Due consideration shall be given to the space required for all other services and allowance made for the thickness of thermal insulation.



- L. All testing, balancing and commissioning shall be in accordance with the relevant section of this specification.



DUCTWORK ACCESSORIES

PART 1 GENERAL

1.1 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 Ductwork Accessories.

1.2 WORK INCLUDED

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

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the manufacture of Ductwork Accessories 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 installation of Ductwork Accessories with at least 5 years successful installation experience on projects of similar nature.

1.4 WARRANTY

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

PART 2 PRODUCTS

2.1 VOLUME CONTROL DAMPERS

- A. All dampers shall be of multi leaf type, sufficiently rigid to prevent fluttering. Unless otherwise indicated the air leakage past dampers in the fully closed position shall not exceed 5% of the maximum design air flow in the duct.



- B. All duct volume control dampers shall be fitted with locking devices and position indicators.
- C. Manual dampers shall be provided for the proper balancing control and isolation of the ductwork system.
These shall be of the multi-leaf opposed blade type. Each damper comprising narrow width low profile aerofoil blades.
- D. Each leaf of a multi leaf damper shall comprise of a low profile aspect ratio aerofoil galvanised steel blade. The blades shall be provided with a totally enclosed galvanised steel reinforced locking rod. Each blade shall be connected to low pressure angle toothed gears in galvanised steel with brass bearings. The gear drive assembly shall be positioned totally out of the air stream in a totally enclosed galvanised steel dustproof control box which shall be externally mounted. The frame shall comprise of a galvanised steel formed inner frame and a roll-formed zintec steel outer frame having integral flanges, pre-punched with elongated holes for connection to the adjoining ductwork.

Quadrants and operating handles shall be of die-cast aluminium with the words 'OPEN' and 'SHUT' cast on the quadrant. Quadrants shall be securely fixed and the damper spindles shall be close fitting in the quadrant hubs to prevent any damper movement when the damper levers are locked.

2.2 FLEXIBLE CONNECTIONS

- A. The flexible duct shall have a liner and a cover of tough tear-resistant fabric equal in durability and flexibility to glass fibre fabric and shall be impregnated and coated with plastic. It shall be reinforced with a bonded galvanised spring steel wire helix between the liner and the cover and an outer helix of glass fibre cord or equal shall be bonded to the cover to ensure regular convolutions.

Alternatively, the flexible duct shall consist of a flexible corrugated metal tubing of stainless steel, aluminium, tinplated steel or aluminium coated steel. The metal may be lined on the inside or the outside or both with plastic material.

- B. The frictional resistance to air flow per unit length of the flexible duct shall not exceed 50% more than the frictional resistance per unit length of galvanised steel ducts of equivalent diameter.
- C. The leakage from any section of flexible duct shall not exceed 1% of the design air flow rate at the static operating pressure.
- D. Flexible ducts shall be suitable for an operating temperature range of -18°C to 120°C and the pressure range of the system. Flexible duct shall comply with BS 476 Part 7 (Class 1 : Surface of very low flame spread).



- E. Flexible ducts of more than 0.5 metre length shall not be permitted.

2.3 SEALANTS, GASKETS AND TAPES

- A. All materials including liquid and mastic sealants shall, when used in connection with ductwork jointing, permanently retain adhesion and elasticity through a temperature range of 0°C to 70°C and pressure range applicable to the system. All sealants shall be UL, FM approved.
- B. Gaskets shall be of a pre-formed roll, sheet or strip. Gaskets shall not be less than 3mm thick for rectangular ducts up to 1500mm (longest side) or circular ducts up to 1250mm diameter. For larger ducts, the gaskets shall not be less than 4mm thick.

PART 3 EXECUTION

3.1 STORAGE

- A. All materials shall be stored on purpose made compartmented racks or shelving within a well lit storage container and suitably covered to prevent the ingress of dirt.
- B. Larger items shall be covered and stored clear of the ground in an area where they are not susceptible to damage.
- C. All items shall be separated by their size, laid out in an orderly fashion and clearly marked for ease of identification.

3.2 VOLUME CONTROL DAMPERS

- A. Dampers shall be installed in the positions shown on the Drawings and where branches or sub-branches leave the main distribution ducts. Sufficient dampers shall be provided to regulate and balance the systems.
- B. Dampers shall be positioned to enable full access to operating handles, and such that position indicators are clearly visible.
- C. Dampers shall be positioned in sufficient length of straight ductwork to enable access doors to be mounted adjacent to the damper.
- D. Dampers shall be installed as remote as possible from terminal devices and ductwork open ends, to prevent regenerated noise being transmitted to the occupied space.



3.3 FLEXIBLE CONNECTIONS

- A. Flexible connections shall be installed as indicated on the Drawings and selected to suit the spigot size of the relevant duct or item of equipment.
- B. Flexible connections shall be secured to spigots with bandclips of a proprietary manufacture.
- C. The use of flexible duct between rigid sections of sheet metal ductwork to change direction or plane will not be permitted except where indicated or expressly authorised by the Engineer.
- D. Radius bends flexible duct shall not be permitted and sets shall be of such a nature that a reduction in the cross sectional area shall not occur.

3.4 SEALANTS, GASKETS AND TAPES

- A. The manufacturer's recommendations and precautions relating to use of sealants, gaskets and tapes shall be strictly complied with.
- B. Sealants, gaskets and tapes shall be applied to the mating surfaces of a joint and joint pulled together such that the form of sealing is under compression. Sealants applied over a joint shall not be permitted.
- C. Self-adhesive tape shall not be permitted as a primary sealant.



AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 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 Air Outlets and Inlets or Air Terminal Devices.

1.2 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 air terminal devices as specified herein and where referred to on the Drawings and Schedules.
- B. Coordination: The Contractor shall be responsible for the full coordination of the work of all trades.

1.3 APPLICABLE CODES AND STANDARDS

- A. The air terminal devices and all associated materials and workmanship shall comply fully with the latest relevant British Standards and ISO Standards. The following are the most commonly used and relevant British Standards and ISO standards associated with air terminal devices and associated materials. However, the Contractor shall ensure that all applicable British Standards and ISO Standards are complied with whether listed here or not.

BS: 4773 : Methods for testing and rating air terminal devices for air distribution systems: Part 1, Aerodynamic testing.

ISO: 5219 : Air distribution and air diffusion: Laboratory aerodynamic testing and rating of air terminal devices.

- B. Applicable industry definitions - refer to schedules.

Given below are definitions of the basic terms to describe the characteristics of ATDs.

Core Area (A_c) The gross area containing all the openings of the ATD.

Free area (A) This is the sum of the smallest areas of the cross-section of all the openings of an ATD.

Effective area (A_o) This is the smallest area of an ATD through which air passes and which may not be equal to its free area. It is given by:

$$A_o = C_d A$$

where A is the free area and C_d is discharge coefficient which usually varies between 0.65 and 0.9.

Free area ratio (R_a) This is the ratio of free area to core area.



Envelope This is a surface of the jet produced by a supply ATD which has the same velocity, usually taken to be 0.25 or 0.5 m/s

Throw (X_m) The maximum distance between the plane of a supply ATD and a plane which is tangential to the jet envelope and perpendicular to the initial jet direction.

Drop or rise (Y_m) The vertical distance between the centre of a supply core and a horizontal plane tangential to the envelope.

Spread (Z_m) The maximum horizontal distance between two vertical planes tangent to the envelope of a supply ATD and perpendicular to a plane through the core axis.

Core velocity (U_c) The volume of air flow rate divided by the core area of the ATD. **Discharge velocity (U_o)** The average velocity at the discharge from an opening of an ATD which is equal to $U_c/(CdRa)$.

PART 2 PRODUCTS

2.1 GRILLES and RIGESTERS

- A. Grilles shall be of aluminum extrusion of the types and sizes indicated on the drawings and in the schedules and be of the concealed fixing type. Where the size is not indicated, the grilles shall be selected for the air volume flow rates indicated in the schedules to achieve the required throw, and be within the relevant noise level for the area being served.
- B. All grilles shall be provided with an aluminum opposed blade multi leaf damper, with loose key to allow adjustment of the concealed adjuster from the face of the grille. One loose key for every 20 grilles shall be provided.
- C. Each supply grille shall have two sets of individually adjustable aluminum blades, one set horizontal the other vertical.
- D. Extract grilles shall be as indicated on the drawings, and in the schedules. Where the grilles does not have to be matched to the supply grille, it shall be of the eggcrate type.
- E. All grilles shall be supplied with a stove enamel paint finish to a BS RAL colour.

2.2 DIFFUSERS

- A. Air diffusers shall be supplied and installed in accordance with the duties, sizes and locations shown on the drawings.
- B. Square diffusers for supply air shall be manufactured from extruded aluminum and shall be supplied complete with opposed blade volume control dampers. Both dampers and grilles shall have concealed screw type fixings. Spring clip fixings shall not be permitted.
- C. Where a supply diffuser is directly connected to a stub duct which has a straight of less than two diameters or equivalent diameters, then an equalizing grid or deflector shall be used.



- D. The frames of all diffusers shall be provided with positive seals with the except of those mounted on exposed ductwork. Frames shall be of a type compatible with the ceiling type or wall finish.
- E. All diffusers shall be supplied with a stove enamel paint finish to a BS RAL colour as approved by the Architect.
- F. All diffusers shall be provided with galvanized steel plenum boxes, lined with acoustic insulation. The plenums shall be sized to match the diffuser and be complete with fixing lugs and incorporate an opposed blade central damper adjustable from the diffuser face and it shall be sized to restrict the re-generated noise level.
- G. The schedules provided indicate volume flows, throws, maximum noise levels and the Contractor shall ensure that the grille and diffuser manufacturer shall assess the data and confirms that his selections comply with the stated parameters.

2.3 LOUVRES

- A. Air intakes shall consist of flanged for wall mounting openings formed in the galvanised sheet steel blanking plates fixed to the rear of the building weather louvres.

PART 3 EXECUTION

3.1 STORAGE

- A. All air terminal devices shall be stored within a well lit container on purpose made shelving. The devices shall be stored in their original packaging to prevent damage to the finish.

3.2 GENERAL INSTALLATION

- A. The air terminal devices shall be identified by reference number as to their final location..
- B. Grilles and diffusers shall be supported independently from the building structure unless otherwise instructed by the Engineer. Grilles diffusers and plenums shall not be supported from the ceiling grid.
- C. All volume control dampers shall be left in the fully open position.
- D. Diffusers shall be securely fixed to ceiling by means of concealed adjustable mounting brackets.
- E. During construction the Contractor shall ensure that the location and fixing of all grilles and diffusers is fully coordinated between the relevant trades.