

**REPUBLIC OF SOUTH AFRICA
DEPARTMENT OF PUBLIC WORKS**



**SUNDUMBILI MAGISTRATE COURT
WCS: 044999
SUPPLEMENTARY TECHNICAL SPECIFICATION
FOR THE
SUPPLY, DELIVERY AND ERECTION
OF
HVAC INSTALLATIONS
(DPW OFFICE)
(2006)**

SUPPLEMENTARY TECHNICAL SPECIFICATION

1. GENERAL

This specification consisting of six pages numbered consecutively is for the supply, delivery installation and commissioning of Air Conditioning, and Ventilation Installations, (Mid-Wall Split type Air conditioners, VRV type air conditioners, and propeller type exhaust fans), and is to read as forming part of the Department of Public Works Standard Specification for Air Conditioning and Ventilation Installations, Issue XI, 1998. The clauses referred to herein are clauses of the Standard Specification, relevant clauses not specifically mentioned shall also apply.

All equipment and installations detailed in this specification shall comply with the requirements of the Occupational Health and Safety Act 85 of 1993.

The Department's Standard Specification for Electrical Installations and Electrical Equipment pertaining to Mechanical Services, Issue IXa, December 1999, shall also apply to this contract.

Where conditions are at variance, this supplementary specification will have preference over both Standard Specifications and drawings.

Copies of the Standard specifications are obtainable from the Director-General: Public Works, Private Bag X 65, Pretoria, 0001. All Standard Specifications are also available on the Department's Website [www.publicworks.gov.za].

2. DRAWINGS

The drawings that accompany this specification are schematic and do not necessarily indicate the exact position, size or detail the construction of equipment. Tenderers must satisfy themselves that the equipment offered by them will fit into the available space and can be positioned so that access for maintenance, repair or removal is not encumbered.

The following drawings form part of, and shall be read in conjunction with, this specification:

Drawing No.	Description
ME1234-ACV1	HVAC – Lower Ground Floor
ME1234-ACV2	HVAC – Ground Floor
ME1234-ACV3	HVAC – First Floor
ME1234-ACV4	HVAC - Second Floor
ME1234-ACV5	HVAC – Third Floor
ME1234-ACV6	HVAC – Roof Layout
ME1234-ACV7	HVAC – Basement Layout

NOTE: All final dimensions are to be verified on site prior to any equipment or material being ordered or manufactured.

DESIGN BASIS – SUNDUMBILI AND BASED ON A 12 HOUR DUTY CYCLE

SCOPE OF WORK

This specification covers the installation of, split type air conditioner units, VRV type air conditioner units and ventilation fans as illustrated in the table above.

SPECIFIC REQUIREMENTS

Every unit shall have electrical back up.

Maximum usage of natural resources with maximum operational efficiencies and with minimal maintenance costs, coupled with highest reliability and availability.

3. VRV/Split Type Air Conditioners

VRV and split type air conditioners of the heat pump type shall be supplied and installed in the positions as indicated on drawing Numbers. Each unit shall have a minimum cooling and heating capacity as stated in the bill of quantities.

All refrigerant piping is to be insulated and secured onto cable tray.

All drains are to be 20mm PVC, Bracketed at 750mm centres, and are to be taken to the nearest drain exact positions to be as agreed on site.

The insulating materials shall comprise pre-formed glass fiber rigid or mineral wool sections of long fine fibers, bonded with a temperature resistant binder. the thermal conductivity shall not exceed 0,038 W/m²K, and the density shall not be less than 80kg/m³. The sections shall be rot-proof, Odorless, non-hygroscopic and non-combustible.

All openings through walls are to be neatly cored sleeved and sealed with foam after installation.

All air conditioners shall be fully adjustable with hot cold controls.

Air conditioner controls shall be ceiling mounted and also supply remote controls.

All units to have reverse cycle heating. (heating and cooling with inverter installed)

The electrical supply and control switch gear as required to make the equipment functional and operational the shall be included in the tender price.

4. In Line Axial Type Exhaust Fans

In line axial type exhaust fans shall be supplied and installed where shown on the drawings, and bill of quantities.

The fans shall have the minimum capacities as stated in bill of quantities and operate at a speed not exceeding 600 r/min.

Flexible connections shall be fitted between fan inlet/discharge and ducting using bolted flanges

Fan casings shall be manufactured from reinforced mild steel with predrilled flanges at both ends ,complete with galvanising.

Impeller hubs and blades shall be die cast aluminium alloy assembled with high tensile steel bolts and nuts.

Internal louvers can be manufactured from plastic materials and external louvers shall be aluminium, or carbon steel with galvanising or powder coating fitted in a neat frame.

The electrical supply and control switch gear as required to make the equipment functional and operational shall be included in the tender price.

The ventilation systems shall discharge to the atmosphere.

All fans shall be supplied with all necessary anti-vibration equipment to ensure that vibration is not transmitted to the ductwork or building structure.

Fan motors shall be suitable for single-phase 220 volt, 50 Hertz electrical supply.

Anti-vermin screens shall be fitted at any inlet or outlet to a ventilation system, to prevent the ingress of any vermin or refuse such as birds, rats, plastics packets etc. These shall take the form of a grid bolted onto the inlet or outlet flange of each system.

With fan(s) on high speed the noise level of the units complete with ducting and sound attenuators shall not exceed a NC rating of 30 at a distance of 2m from the diffusers.

The units shall be selected at medium fan(s) speed.

The mounting feet of the inline axial fan shall be 3mm galvanised plate, carbon steel plate.

The minimum required volume shall be capable of replacing the required air volume by ten times per hour

Wall Mounted Type Ventilation Fans

In a single area a wall mounted fan is required, the fan will be mounted to the wall, and the ventilation systems shall discharge to the atmosphere.

The fan motors are to be class I, totally enclosed, lubricated for life, fitted with a thermal overload and suitable for continuous operation.

The electrical supply and control switch gear as required to make the equipment functional and operational shall be included in the tender price.

Internal louvers can be manufactured from plastic materials and external louvers shall be aluminium, or carbon steel with galvanising or powder coating fitted in a neat frame.

Anti-vermin screens shall be fitted at any inlet or outlet to a ventilation system, to prevent the ingress of any vermin or refuse such as birds, rats, plastics packets etc. These shall take the form of a grid bolted onto the inlet or outlet flange of each system. Internal Screen colour shall be White and External Screen shall be the face brick.

With fan(s) on high speed the noise level of the units complete and sound attenuators shall not exceed a NC rating of 22db at 3m.

The fans shall have the minimum capacities as stated in bill of quantities and operate at a speed not exceeding 600 r/min.

The minimum required volume shall be capable of replacing the required air volume by ten times per hour.

Extraction Fan

The extraction fan shall be a mixed flow, Horizontal discharge unit mounted on the roof as shown and shall extract air at a rate of 3500l/s at 150 Pa. The diameter of the fan shall be 710mm and the colour of the roof cowl must match the roof sheeting. The fan shall be supplied with class IP55 enclosure and Class F insulation. The fan speed shall not exceed 680rpm.

The electrical supply and control switch gear as required to make the equipment functional and operational shall be included in the tender price.

Sound Attenuator

The exhaust system shall be provided with a sound attenuator as shown. The attenuator shall be of the cylindrical type with pods similar to Donkin AS2 or as supplied by Luft. The acoustic media shall be melinex lined to prevent the ingress of moisture. Attenuators to ensure a maximum noise level of NR 45 (50 dbA) measured at 1m from the canopy filters.

Painting

All exposed steel surfaces, excluding galvanized and stainless steel, shall be painted. All mild steel surfaces to be painted shall be prepared according to SABS 064 (Code for the preparation of steel surfaces for painting). Thereafter the surfaces shall be painted with a zinc chromate primer, followed by one coat of universal undercoat and one final coat of high gloss enamel paint, the colour of which will be determined by the Engineer.

Guarantee Period

All mechanical equipment and installations are subject to a 12 month guarantee from date of first delivery. Contractors shall repair any such defects without delay and at their own cost. This guarantee shall include malfunctions, leaks and adjustments. Should any part of the mechanical installation perform unsatisfactory so as to become detrimental to its functional use, the contractor shall replace any such part, or the complete installation, with equipment as prescribed by the engineer, without delay and at his own cost.

**REPUBLIC OF SOUTH AFRICA
DEPARTMENT OF PUBLIC WORKS**



**SUNDUMBILI MAGISTRATE COURT
WCS : 044999**

**SUPPLEMENTARY TECHNICAL SPECIFICATION
FOR THE
SUPPLY, DELIVERY AND ERECTION
OF
HOT WATER GENERATION INSTALLATIONS**

(DPW OFFICE)

(2006)

2.1. **GENERAL**

This part of the specification is for the supply, delivery, installation and commissioning of the hot water generation installation at the Sundumbili Magistrates Court in KZN.

If any of the requirements as stated in this part of the specification is at variance or contradictory with requirements contained in other parts or drawings, then the requirements of this specification shall have preference.

Tenders shall conform strictly to the requirements of this document. Alternative offers put forward by a tenderer, shall be submitted as fully separate alternative offers.

All equipment and installations shall comply with the requirements of the Occupational Health and Safety Act No. 85 of 1993.

Department of Public Works Standard Specification for Electrical Installations and Electrical Equipment Pertaining to Mechanical Services Issue IXa, December 1999 shall also apply to this contract.

Department of Public Works Standard Conditions in Respect of the Supply-, Delivery and Installation of Electrical-, Mechanical-, Pneumatic- and Vacuum Operated Equipment, Control Systems, Plant and Materials PW 379 September 2003 shall also apply to this contract.

Copies of the abovementioned documents are obtainable from www.publicworks.gov.za.

2.2. **DRAWINGS**

The drawings that accompany this specification are schematic and do not necessarily indicate the exact position, size or detail the construction of equipment. Tenderers must satisfy themselves that the equipment offered by them will fit into the available space and can be positioned so that access for maintenance, repair or removal is not encumbered.

The Following drawings form part of, and shall be read in conjunction with, this specification:

Item No	Drawing No	Floor	Service
1	ME1234/HWS1	Lower Ground Floor	Hot Water Systems
2	ME1234/HWS2	Ground Floor	Hot Water Systems
3	ME1234/HWS3	First Floor	Hot Water Systems
4	ME1234/HWS4	Second Floor	Hot Water Systems
5	ME1234/HWS5	Third Floor	Hot Water Systems

NOTE: All final dimensions are to be verified on site prior to any equipment or material being ordered or manufactured.

2.3. SCOPE OF WORK

This contract is for the hot water generation installation at the Sundumbili Magistrates Court in KZN and includes wholly, but may not be limited to, the supply, delivery, and installation and commissioning of the hot water equipment and the accessories.

The following items shall form part of the contract and is also included in the scope of work:

- a) The supply, delivery, installation and commissioning of heat pump and storage tanks and as shown on the accompanying drawings and as listed in the Schedules of Equipment.
- b) The installation and commissioning of all non-return, safety relief, isolating and drain valves as shown on the accompanying drawings and as listed in the Schedules of Equipment.
- c) The supply, delivery and installation of all supports, brackets, hangers, pipe racks and accessible as are required for the proper fixing and support of the hot water equipment.
- d) The supply, delivery and installation of any sundry items not specifically mentioned in the documentation but necessary for the completion of the works.

2.3.1. DESIGN CONDITIONS

The design shall be based on Sundumbili located in Kwa-Zulu Natal.

2.3.2. OPERATION

The normal operation shall be as follows:

Cold domestic water shall enter the heat pump storage tank.

The heat pump shall be set to activate at 10°C and switch off at 60°C.

Heat pump storage tank protection shall be safety relief valve and also electrical isolation at the 60°C.

Materials

All materials shall be 316L grade of stainless steel.

Construction

All bending, forming and fabrications methods shall be of high quality and welding shall be completed using the GTAW process. All welds shall be pickled and passivated.

Insulation

Rock mineral wool insulation must have a minimum density of 224kg/m³ and fiber glass a minimum density of 96kg/m³ with thermal conductivity of between 0.03 – 0.045 W/m°C.

Minimum thickness shall be 50mm per side.

Cladding

External stainless cladding shall be 0.5mm thick, riveted with a minimum overlap of 50mm.

Rivet head shall be greater than 10mm in diameter.

Mounting & Securing

All tanks shall be mounted with due regard to future maintenance and replacement.

Stainless steel (316L) Base plates 5mm x 200mm x 200mm with holding down bolts shall be fitted and secured.

Stainless steel holding down bolts to be included as is required.

4.2.5 Tank and system pressure testing

Once all tanks are fabricated they shall be subject to pressure test of 500kpa and also internal inspection before insulating and cladding materials are installed.

After completion, but prior to hand over, the completed installation (hot and cold water) is to be pressure tested to 500 kPa for a period of 30 minutes, in the presence of the Engineer. Note that the contractors are to perform their own preliminary test, any repair and leaks, prior to the final pressure test.

HEAT PUMPS

Heat pumps shall be of the air-to-water, water-to-water or air-to-air.

- 4.6.2 Refrigerant to water heat exchangers shall be corrosion resistant and suitable for use with the local water at high temperature and flow velocities.
- 4.6.3 Shell and tube condensers are preferred for air to water applications.
- 4.6.4 Heat pumps shall be completely self-contained units with stainless steel or epoxy powder coated casings and cladding, suitable for permanent outdoor use where required.
- 4.6.5 Condenser and condenser piping circuits shall be properly insulated.
- 4.6.6 A condensate drip pan of stainless steel 430 shall be fitted and piped to the nearest building drain, allowing for defrost cycles.
- 4.6.7 Heat pumps shall be selected for a maximum compressor running operation of 20 hours per day and of a heavy duty construction.
- 4.6.8 Reverse cycle automatically controlled defrost shall be provided as standard. Defrost shall be demand controlled and not timer controlled.
- 4.6.9 The heat pump shall be suitable for operating with ambient wet bulb temperatures as low as -10°C and as high as 35°C.
- 4.6.10 Heat pumps for central heating hot water shall heat the water to 60°C (or as specified) and shall be selected to ensure correct functioning with water inlet temperature as low as 40°C and as high as 50°C.
- 4.6.11 Heat pumps with a coefficient of performance (COP) of less than 3.0 at ambient wet bulb temperature of 10°C with secondary circuit inlet temperature 40°C will not be acceptable.
- 4.6.12 Each heat pump shall be fitted with a control and fault indication panel to provide status indication on fault occurrence and operation mode.
- 4.6.13 A flow switch shall be fitted to the water or air secondary circuit and the heat pump control interlocked with the flow switch.
- 4.6.14 Heat pumps shall be fitted with head pressure control set at ensuring constant 60°C water supply temperature at all possible water inlet temperatures and flows.

- 4.6.15 Compressors shall be well known products of an approved manufacturer.
Motor windings shall be suitable for the temperatures experienced in heat pump applications, particularly hermetically sealed units.
- 4.13 Operating pressures and temperatures shall comply with the manufacturer's recommendations.
- 4.6.16 Provision shall be made in the refrigerant circuits for liquid collection during periods of not being in use.
- 4.6.17 The compressor shall be interlocked with the evaporator fan/s and the flow switch to prevent operation unless these elements are functional.
- 4.6.19 Controls shall be fitted to prevent compressor short cycling on low demand.
- 4.6.20 Crankcase heaters shall be fitted where application and unit size warrants the use thereof.
- 4.6.21 Where a standby heater is required with a heat pump application the standby heater shall be switched on automatically on heat pump failure with heating called for.
- 4.6.22 Suction- and discharge pressure gauges shall be provided on the instrument panel.
- 4.6.24 Easily detachable/ opening panels of rigid construction giving access to all working parts of the unit shall be provided.

SECURING HEAT PUMP

- a) Heat pump shall be secured with galvanized or stainless epoxy grouted studs and rubber mountings fitted to prevent transfer of vibrations.
- b) Height of the ground shall be a minimum of 100mm.
- c) All inlet and outlet pipes from the heat pump shall be rubber /stainless steel braiding type suitable for 100 °C and not transmit any vibrations.

FITTINGS

All screwed, welded fittings, bends, reducers, Tee pieces, nipples, unions shall be a minimum class 2 or greater and suitable for copper piping.

4.14.9 Gaskets

For temperatures of 100°C and above all gaskets shall either be metallic joint rings equal to Taylor metal joint rings, or they shall be made from graphite compressed mineral fiber with a minimum thickness of 1.6mm. For temperatures below 100°C, compressed mineral fiber joints rings may be used.

4.15 VALVES NON-RETURN VALVES AND STRAINERS

4.15.1 General

All valves and fittings shall be suitable for a minimum working pressure of 1000 kPa and a working temperature of 100°C.

4.15.2 Valve

Valves shall be of gunmetal and shall be the full way ball type.
Main shut-off valves shall be rated for a minimum working pressure of 1000 kPa.
Valves of 50mm and larger shall be flanged.
Smaller valves may be screwed.

4.15.3 Pressure Reducing Valves

Brass pressure reducing valves shall be as specified on the main drawing and shall be installed with suitable isolating valves.

4.15.4 Non Return Valves

Non return valves shall be screwed and suitable for a working pressure of not less than 1300kPa.

All non-return valves shall be bronze trimmed and shall seal drop tight.
Non-return valves shall be suitable for horizontal or vertical mounting.

4.15.5 Pressure Relief Valves

Pressure relief valves should be of the spring-loaded diaphragm guided type. The body shall be bronze and suitable for a working pressure of 1000 kPa. The valve seat shall be bronze, resilient material or stainless steel. The spring shall be cadmium-plated steel, with spindle and spring plate being bronze. The valve shall be selected for the maximum required flow allowing for a 15 kPa pressure drop across the valve. The valve shall not require a variation of more than 10% of the controlled pressure to cause it to open fully. The final pressure setting shall be locked by means of a padlock.
The safety valve shall discharge to a safe position outside the building.

4.15.6 Strainers

Strainers shall be of the Y-leg type with bronze body up to and including 50mm diameter and cast iron body above 50 mm. Strainers shall be fitted with a stainless steel or monel metal screen mesh size 100 with a screw on or bolted cap. The total free area of the screen shall be equivalent to at least twice the area at the entering port.

4.15.7 Air vent valves

Air vent valves shall be installed at all points in the piping system where air may accumulate.
These valves shall be float operated vent valves and shall be similar or equal to Spirax AE 600 air eliminators.

Discharge connections from air eliminators shall be taken by means of 20mm piping (either galvanised or copper) to the nearest drain point.

All air eliminators shall be fitted with a suitable isolating valve to enable it to be removed for maintenance while the system is under pressure.

It is essential that a suitable strainer be fitted immediately up-stream of each vent valve.

14.18 PRESSURE AND TEMPERATURE TRANSDUCERS

14.18.1. Pressure transducers

Pressure transducers shall be fitted as per control panel requirements.

14.18.2 Temperature transducers

Temperature transducers shall be installed as per the control panel requirements.

PIPE JOINTS

4.19.2 Threaded Joints

All pipe threads shall be right handed, Whitworth Standard taper pipe threads and shall comply with BS21 or ISO R7. Threaded pipe joints shall be made with either an approved steam pipe jointing compound or PTFE Tape.

All surplus compound or tape shall be cleaned off the joints before painting or finishing off.

4.19.3 Welded Joints

All welded pipe joints shall be of a high standard and carefully prepared for welding.

All edges and holes shall be correctly beveled and shaped.

Welded joints shall be thoroughly cleaned after welding and all slag and other foreign material removed.

All welding shall comply with relevant SABS specifications, BS2971 or BS2640 Class I Welding.

Only silver solder welding shall be allowed.

PIPING ,LAGGING AND CLADDING

2.1.1. Water piping and Fittings

The supply, delivery, installation and commissioning of the complete water piping and fittings for the installation shall form part of this contract.

Over and above the specified equipment, the Contractor shall supply and install all equipment and auxiliary equipment which may be considered necessary for the proper and safe operation of the complete installation, to fully comply with the requirements of the specification.

The water shall be conveyed to all parts of the installation using suitably sized class 2 copper pipes and fittings.

Fixing of Pipes

Pipes are to be neatly fixed to the timber uprights, with copper saddles and making provision for expansion (by incorporating 500mm vertical steps at approximately 12m centres), and making provision for other services.

No Pipes are to be laid across slabs or on top of rafters.

4.3.1 Pipe Insulation

All hot water must be insulated throughout with plain performed sections of fiber glass or mineral wool insulation. Asbestos type insulation, in whatever form, is unacceptable.

Rock Mineral wool insulation must have a minimum density of 224kg/m³ and fiber glass a minimum density of 96kg/m³ with thermal conductivity of between 0.03 – 0.045 W/m°C.

The following minimum thickness of insulation is required:

Pipe size	Thickness of Preformed Sections
Up to 40mm diameter	25mm
50mm to 80mm diameter	40mm

Preformed insulation sections must be fixed in place by means of 15mm wide bands of aluminium or similar non-corroding material applied at the rate of at least two per meter on insulation.

Specification for Copper Tubes

Copper pipes for domestic water in all cases shall comply with the requirements of S.A.B.S - 460 Class II, For applications below ground either Class II or III shall be used, wrapped with Denso tape, or similar.

Pipe application above ground shall be of class II, Jointed with capillary soldered fittings. Provisions must however be made for union couplings in strategic places.

Pipes shall be firmly and neatly built in or fixed to walls, as directed by the Engineer, with brass holder bats, saddles, or brackets for pipes up to and including 50mm Diameter or to timber work with brass or copper pipe clips screwed on with brass screws.

Jointing of Copper tubes

Unless otherwise specified, all copper pipes shall be jointed with approved capillary solder type fittings, each joint being formed by cutting the pipe-ends square, preferably with a pipe cutter. If the tube end, to be soldered, is dirty due to cement, bitumen or tape-gum, it should be mechanically cleaned with steel wool or abrasive paper.

Wall Buried Services

Where avoidable, no pipes are to be buried in walls or floors. Where unavoidable, the buried section of piping shall include no joints (i.e. Labour bends only) at wall penetrations, all pipes are to be provided with P.V.C Sleeves.

4.3.4 Above Ground Pipe Runs

All pipe work both vertical and horizontal shall be supported along its length with brackets capable of carrying the combined mass of the pipe and water and shall be spaced at the following maximum centers:

Pipe hangers are to consist of galvanized or stainless steel chain and copper pipe rings. Holder batts are to be brass or gunmetal with wall screw mountings and screwed on covers.
N.B: No plastic batts will be permitted.

Copper and Galvanized Steel Tubes

Diameter of pipe (mm)	15-22	28-35	42-54	76-108
c/c brackets/ hangers/ holderbats (mm)	1200	2000	2500	3000

All copper pipes shall be electrically insulated with P.V.C from ferrous pipe clamps.

4.3.5 Expansion of Pipes

All straight long runs in copper tubing shall be interrupted every 15m with an offset or expansion loop.

Configuration

The hot water generating plant layout shall consist of the items as shown on this schematic.

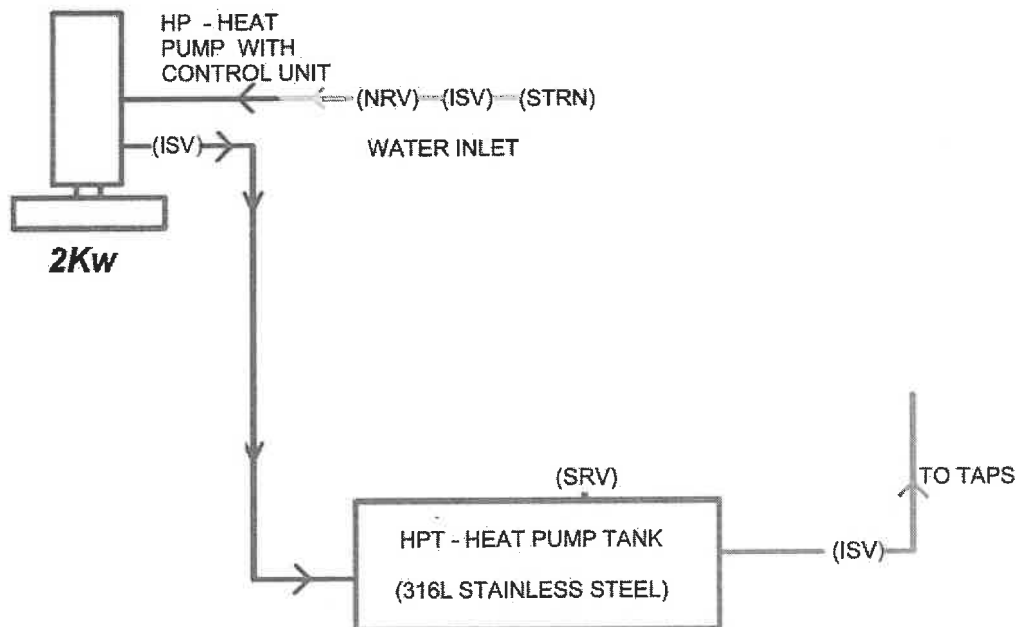


Figure 5.19 – 1: General layout of Hot Water Installation

2.3.3. Control system

The supply, delivery, installation and commissioning of the complete control system for the hot water installation form part of this contract.

Over and above the specified equipment, the Contractor shall supply and install all equipment and auxiliary equipment which may be considered necessary for the proper and safe operation of the complete installation, to fully comply with the requirements of the specification.

- Over pressure protection on all heat pump tanks via a 25mm brass safety relief valve set at 300kpa.
- To prevent reverse flow 25mm ,brass non return valves shall be fitted before :
- Water inlet into heat pump and outlet side of the heat pump storage tank
- Water strainers, 25mm brass shall be fitted before water enters the Heat Pump.
- Electrical isolation of heat pump when temperature of 60°C is achieved.
- Electronic panel to be housed inside a stainless steel enclosure for setting the operating and control parameters.

2.3.4. Ingress Protection

All electric and mechanical moving parts and equipment shall be suitably protected by an enclosure which shall prevent the ingress of rain, surface water and dust.

2.4. MAKE OF EQUIPMENT

The Contractor will be allowed to offer any make of equipment for consideration, under the following explicit conditions:

- a) The equipment shall comply in all respects with the requirements specified and shall be subject to approval by the Engineer.
- b) The delivery period for such equipment shall not jeopardize the construction programme.
- c) The local manufacturer or supplier shall have adequate service facilities and/or keep sufficient stocks of spares required for servicing.
- d) The Contractor shall supply such information regarding the equipment as required by the Engineer.

2.5. PERFORMANCE

Although the Engineer took the requirements set out below into consideration at design stage, the Contractor shall, in the preparation of his manufacturing drawings and execution of the construction phase, take the necessary precautions and care to be able to guarantee:

- a) That the installation shall function without excessive noise or vibrations.
- b) That equipment shall be installed, commissioned and set properly in order to operate as intended and specified.
- c) That an installation shall be satisfactorily erected which will function in a safe and satisfactory manner in every respect and will be fit for the purpose for which it is intended.

2.6. DRAWINGS

After award of the tender, the Contractor shall visit the site and shall survey the building and surroundings. The Contractor shall then prepare detailed workshop drawings for approval. Tenderers shall ensure that the equipment offered by them will fit into the available spaces and can be positioned so that access is provided for maintenance, repair and removal.

The Contractor shall produce, and submit for approval, comprehensive, detailed, dimensional manufacturing (workshop) drawings of all pneumatic and mechanical systems.

Unless otherwise specified, the Engineer's drawings are not manufacturing drawings and the dimensions given are only sufficient for tendering purposes or to enable the Contractor to complete manufacturing drawings. It is the responsibility of the Contractor to verify all dimensions from drawings and on site.

The Contractor will be furnished with the relevant Saiba drawings as well as the drawings of the other professional disciplines as required.

The Contractor shall supply three (3) copies of all workshop drawings. The Contractor shall allow three (3) weeks for drawing approval. After a marked-up copy with all the comments has been returned, the

Contractor shall update the original which shall then be submitted for signature. This will ensure that all prints used for construction will be certified as approved.

In the production of the workshop drawings the Contractor shall be responsible to ensure coordination with the structure and other services.

Unless otherwise specified, cable routes shall be superimposed on the mechanical layout drawings.

Any work done by the Contractor without an approved signed drawing, shall be at the risk of the Contractor.

The Contractor shall be required to finalise and coordinate routes for water piping and interconnecting cables and shall indicate these in detail on the drawings.

The Contractor shall update all drawings ("as built") drawings on an ongoing basis. Three (3) sets of final paper prints plus a compact disc copy of all the drawings in "Drawing Exchange Format (.dxf)" shall be supplied to the Engineer as part of the Operating and Maintenance Manual.

The Contractor shall include for his representative to keep a diary recording the progress of the works and details of all instructions received. The diary shall be at the disposal of the Engineer when required.

The Contractor shall provide working drawings of all items of equipment, with a detailed technical specification of the equipment, for approval before placing an order for the equipment.

2.7. LAYOUT OF PLANT

The plant shall comply in capacity and general layout with the details given in the specification and drawings.

The general layout may be altered or modified to suit equipment, but a sketch showing the intended layout must be submitted to the Engineer before the tender is awarded.

Dimensions shown on the drawings are sufficiently accurate for tendering purposes, but when workshop drawings are being prepared and before construction of the plant is commenced critical dimensions together with the position of roof members, etc., must be verified on site by the Contractor and the plant must be drawn and constructed accordingly. If the Contractor requires alterations to the structure, these must be described at the time of tendering. Minor structural alterations which might facilitate the work can, where possible, be arranged with the Engineer as the work progresses, but no claims will be entertained for alterations to items which were constructed before the necessary dimensions and details had been verified.

2.7.1. Schedule of particulars

The type and quantity of all equipment shall be as per the Schedule of Equipment hereunder and as repeated in the schedules on the Saiba Mechanical drawings and also in the bill of quantities.

2.7.2. Safety requirements

The entire installation as well as any activities on site, shall comply with the Occupational Health and Safety Act no 85 of 1993 and other relevant standards.

2.8. ELECTRICAL INSTALLATION

The supply, delivery, installation and commissioning of the electrical installation is excluded from this mechanical scope of works. The instrumentation and control in field to control room is required.

2.9. PAINTING

All exposed steel surfaces, excluding new galvanised and stainless steel, shall be painted. All steel surfaces to be painted shall be prepared according to SANS 10064:2005 *The preparation of steel surfaces for coating*. Thereafter the surfaces shall be painted with a zinc chromate primer, followed by one coat of universal undercoat and one final coat of high gloss enamel paint, the colour of which will be determined by the Engineer in collaboration with the end user.

2.10. INSPECTIONS AND TESTING

2.10.1. Inspections

The Engineer shall have general supervision and direction of the contract works. Supervision shall comprise such periodic visits as the Engineer may consider necessary to inspect the contract works for conformity with the contract documentation and to provide clarification and further information as necessary.

The Engineer shall have the power at any time to inspect and examine any part of the contract works or any materials intended for use in or on the contract works, either on the site or at any factory, workshop or other place where same are laying or from where they are being obtained, and the Contractor shall give all such facilities as the Engineer may reasonably require to be given for such inspection and examination.

2.10.2. Testing

Refer to the *Department of Public Works Standard Conditions in Respect of the Supply-, Delivery and Installation of Electrical-, Mechanical-, Pneumatic- and Vacuum Operated Equipment, Control Systems, Plant and Materials PW 379 September 2003*

The Contractor shall supply all test equipment, test facilities and everything necessary, to test the installation.

Prior to switching on each system, the Contractor shall ensure that all the statutory safety requirements are complied with.

The Contractor shall record all measurements taken during testing and shall do the necessary adjustments until the Engineer is satisfied with the results.

The Engineer shall be notified one (1) week in advance of any tests so that he may witness such tests.

Unless otherwise specified, the Contractor will be required to perform, inter alia, the following tests and measurements:

The Contractor shall perform all tests and demonstrations as the Engineer may reasonably direct and require to properly verify and demonstrate that the installations are performing as specified and are delivering the capacities as specified.

2.11. OPERATING AND MAINTENANCE MANUAL

The Contractor shall, at his cost, supply detailed O&M Manuals on completion of the work to enable proper operation and maintenance of the installation.

Six (6) weeks prior to the commencement of commissioning, the Contractor shall supply a draft of the manual for approval. Two (2) weeks after commissioning, the Contractor shall supply three (3) additional manuals which have been updated and include all commissioning data and "as built" drawings. These manuals shall contain the following information:

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SECTION 1: SYSTEM DESCRIPTION

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- 2.2. Starting and stopping instructions*
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SECTION 3: MECHANICAL EQUIPMENT

The following information shall be provided in full for each new item of equipment:

- 3.1. General information: Description, make, model number, name and address of supplier, manufacturer, etc.*

3.2. Design information:

- 3.2.1. Design data sheet containing all design and selection parameters, calculations, selection curves, etc.*
- 3.2.2. Flow diagrams that indicate the flow rates, temperatures, pressures and pressure drops amongst others in the system.*

3.3. Manufacturer's brochures and pamphlets including performance curves/tables for all individual items of equipment.

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SECTION 7: DRAWINGS

7.1. The Contractor will be required to produce the following detailed "as built" design drawings for inclusion in the manual:

- 7.1.1. Builder's work drawings.
- 7.1.2. Mechanical drawings
- 7.1.3. Instrumentation and control drawings

2.12. COMMISSIONING AND HANDING-OVER

2.12.1. General

Commissioning shall be performed by the Contractor after the installation is completed to specification. The Contractor shall follow recognized standard commissioning codes such as SANS, SMACNA, CIBSE. In particular, the Contractor shall operate each system for 100 iterations. The Contractor shall submit the proposed codes and his commissioning plan to the Engineer for approval in good time.

The following general procedure shall be followed:

Form A

After physical completion of the erection of each phase of the installation, the Engineer will upon request issue of a Form A certifying that commissioning can proceed. Erection items which would not influence commissioning, but which shall be attended to during commissioning, will be recorded on the Form A.

Form B

After commissioning the Engineer will issue a Form B. Any outstanding work will be recorded on the Form B.

Form C

After completion of all outstanding items and receipt of all manuals and drawings as recorded on Form B, the Engineer will issue a COMPLETION CERTIFICATE: Form C. Form C shall under no circumstances be issued before all items on punch list are completed to the satisfaction of the Engineer.

The maintenance and guarantee period of one year will commence on the date on Form C.

Samples of Forms A, B and C shall be made available, upon request, to the Contractor before the commencement of commissioning.

2.12.2. Training

The Contractor shall provide a suitable qualified and trained person to train the Owner's staff in the correct operation and maintenance of the installation. The Contractor shall allow for this person to be based on site for a period of at least one (1) month after the hand-over date.

2.13. MAINTENANCE AND SERVICING

The contractual guarantee period shall be at least one (1) year on faulty materials and workmanship.

During the guarantee period, the Contractor shall be fully responsible for complete maintenance of the installation. The guarantee period on material, equipment and labour performed commences on the date as specified above and when the completion certificate is issued by the Engineer and expires one calendar years later.

Maintenance of the installation shall mean the regular servicing, lubrication, repairing, cleaning and adjustment of the installation as well as the free of charge replacement of any defective components during the guarantee period.

A competent service man shall visit the installations at least once every three (3) months or as frequently as stipulated by the suppliers, and shall service, clean, adjust and test the installation.

Breakdown/emergency calls shall immediately, on the day of first call-out, be attended to by the Contractor. In the event of non-performance by the Contractor in this respect, the owner shall be entitled to make such other arrangements as are necessary at the Contractor's expense

A logbook shall be kept in the main plant room and all servicing and repairs shall be recorded in this logbook with meticulous care. The logbook shall at all times be put at the disposal of the Engineer. Logbook of detailed services and repairs shall be provided to the owner by the Contractor after the guarantee period has expired.

Additionally the Client shall be given a three (3) year guarantee on all the compressors.

2.14. SCHEDULES OF EQUIPMENT

All schedules which accompany this tender notice form an integral part of it and shall be duly completed in every detail;

2.14.1. Heat pumps

DESIGNATION	TYPE
Heat Pumps	Heavy duty heat pump for 20 hour per day usage
Water circulation	Wilo /Grundfos or equivalent

2.14.2. Heat pump storage tanks

DESIGNATION	TYPE
Heat pump storage tanks	Stainless steel tanks -316Lx3mm thick as per specification

2.14.3. Valves ,pipes, fittings & accessories

DESIGNATION	TYPE
Safety Relief valves	Brass ,25mm ,screwed, piped to discharge into drain with copper pipe, hot water type
Non Return valves	Brass ,25mm , flap type ,screwed ,suitable for hot water @ 100°C
Isolating /drain valves	Brass ,25mm ,ball type , suitable for hot water @ 100°C
Pipes	19mm,25mm and 50mm class 2 copper
Strainers	Brass ,25mm ,screwed ,suitable for water applications
Fittings	All unions, bends ,T pieces ,elbows ,reducers etc as is required
Control panel	Electronic control panel
Pressure reducing valves	Brass, 25mm, screwed suitable for water applications.
Instrumentation/Control	Required in field and also display in control room on one system



DEPARTMENT OF PUBLIC WORKS

STANDARD SPECIFICATION FOR DOMESTIC AND FIRE WATER STORAGE AND FIRE WATER SUPPLY FOR PUBLIC BUILDINGS

MAY 2004

DEPARTMENT OF PUBLIC WORKS

STANDARD SPECIFICATION FOR DOMESTIC AND FIRE WATER STORAGE AND FIRE WATER SUPPLY FOR PUBLIC BUILDINGS

NOTE:

THE FOLLOWING STANDARDS SHALL APPLY EXCEPT WHERE THE RELEVANT LOCAL AUTHORITY REQUIRES HIGHER STANDARDS IN WHICH CASE THE STANDARDS OF THE LOCAL AUTHORITY SHALL APPLY.

1. MINIMUM REQUIRED DESIGN FIRE FLOW

1.1 IN ESTABLISHED CITIES AND TOWNS WITH FIRE HYDRANTS IN STREETS AND OPERATIONAL FIRE BRIGADES WITH RELIABLE WATER SUPPLIES

Area classification in accordance with the Guidelines for Human Settlement Planning and Design (Red Book)	Public building installations	Minimum available fire water from Local Authority	Min required simultaneous fire water flow for public building(s)	
			From fire hydrants	From hose reels
High risk areas	Military installations	200ℓ/s	20ℓ/s per hydrant from <u>minimum</u> number of hydrants <u>required</u> for <u>any area of the site not exceeding 270m radius</u> from any fire (buildings + site + nearby street hydrants)	0,5ℓ/s per hose reel from all hose reels in an <u>individual</u> building
	Public administration building	200ℓ/s	20ℓ/s per hydrant from <u>minimum</u> number of hydrants <u>required</u> for <u>site</u> (building + site + adjoining street hydrants)	0,5ℓ/s per hose reel from all hose reels in <u>any fire division</u> of building
Moderate risk areas	Public administration building	100ℓ/s	20ℓ/s per hydrant from minimum number of hydrants required for site (building + site + nearby street hydrants) up to a maximum of 4 hydrants	0,5ℓ/s per hose reel from all hose reels in any fire division of building
	Magistrates courts	100ℓ/s	20ℓ/s per hydrant from minimum number of hydrants required for site (building + site + nearby street hydrants) up to a maximum of 4 hydrants	0,5ℓ/s per hose reel from all hose reels in any fire division of building
	Police stations	100ℓ/s	20ℓ/s per hydrant from minimum number of hydrants required for site (building + site + nearby street hydrants) up to a maximum of 4 hydrants	0,5ℓ/s per hose reel from a maximum of 3 hose reels
Low Risk Group 1 area	Police station			
	a) Without prisoner cells	≥ 15ℓ/s	20ℓ/s per hydrant from minimum of 1 nearby hydrant in street or on site	0,5ℓ/s per hose reel from a minimum of 2 hose reels
	b) With prisoner cells	≥ 15ℓ/s	20ℓ/s per hydrant from minimum of 1 nearby hydrant in street or on site	0,5ℓ/s per hose reel from a minimum of 3 hose reels

Area classification in accordance with the Guidelines for Human Settlement Planning and Design (Red Book)	Public building installations	Minimum available fire water from Local Authority	Min required simultaneous fire water flow for public building(s)	
			From fire hydrants	From hose reels
	Prison			
	a) ≤ 1000 prisoners	≥ 15ℓ/s	20ℓ/s per hydrant from minimum of 2 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building
	b) 1000 – 2000 prisoners	≥ 15ℓ/s	20ℓ/s per hydrant from minimum of 3 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building
	c) > 2000 prisoners	≥ 15ℓ/s	20ℓ/s per hydrant from minimum of 4 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building
Low Risk Group 2 area	Police station			
	a) Without prisoner cells	≥ 8,3ℓ/s	20ℓ/s per hydrant from minimum of 1 nearby hydrant in street or on site	0,5ℓ/s per hose reel for minimum of 2 hose reels
	b) With prisoner cells	≥ 8,3ℓ/s	20ℓ/s per hydrant from minimum of 1 nearby hydrant in street or on site	0,5ℓ/s per hose reel for minimum of 3 hose reels
	Prison			
	a) ≤ 1000 prisoners	≥ 8,3ℓ/s	20ℓ/s per hydrant from minimum of 2 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building
	b) 1000 – 2000 prisoners	≥ 8,3ℓ/s	20ℓ/s per hydrant from minimum of 3 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building
	c) > 2000 prisoners	≥ 8,3ℓ/s	20ℓ/s per hydrant from minimum of 4 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building
Low Risk Group 3 area	Police station			
	a) Without prisoner cells	≥ 5,8ℓ/s	20ℓ/s per hydrant from minimum of 1 nearby hydrant in street or on site	0,5ℓ/s per hose reel for minimum of 2 hose reels
	b) With prisoner cells	≥ 5,8ℓ/s	20ℓ/s per hydrant from minimum of 1 nearby hydrant in street or on site	0,5ℓ/s per hose reel for minimum of 3 hose reels
	Prison			
	a) ≤ 1000 prisoners	≥ 5,8ℓ/s	20ℓ/s per hydrant from minimum of 2 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building
	b) 1000 – 2000 prisoners	≥ 5,8ℓ/s	20ℓ/s per hydrant from minimum of 3 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building
	c) > 2000 prisoners	≥ 5,8ℓ/s	20ℓ/s per hydrant from minimum of 4 nearby	0,5ℓ/s per hose reel from all required hose

Area classification in accordance with the Guidelines for Human Settlement Planning and Design (Red Book)	Public building installations	Minimum available fire water from Local Authority	Min required simultaneous fire water flow for public building(s)	
			From fire hydrants	From hose reels
			hydrants in street and/or on site	reels in any individual building
Low Risk Group 4 area	Police station			
	a) Without prisoner cells	-	20l/s per hydrant from minimum of 1 nearby hydrant in street or on site	0,5l/s per hose reel for minimum of 2 hose reels
	b) With prisoner cells	-	20l/s per hydrant from minimum of 1 nearby hydrant in street or on site	0,5l/s per hose reel for minimum of 3 hose reels
	Prison			
	a) ≤ 1000 prisoners	-	20l/s per hydrant from minimum of 2 nearby hydrants in street and/or on site	0,5l/s per hose reel from all required hose reels in any individual building
	b) 1000 – 2000 prisoners	-	20l/s per hydrant from minimum of 3 nearby hydrants in street and/or on site	0,5l/s per hose reel from all required hose reels in any individual building
	c) > 2000 prisoners	-	20l/s per hydrant from minimum of 4 nearby hydrants in street and/or on site	0,5l/s per hose reel from all required hose reels in any individual building

NOTE:

- Where minimum required firewater flow is *more* than that available from the Local Authority, on site firewater flow shall be augmented by storage for the shortfall in flow.
- Minimum required hydrants are determined by the maximum distances between all hydrants and the buildings as specified in this Document.
- The required number of hose reels in the buildings will be determined by the Architectural Division of the DPW in terms of SABS 0400.
- Under the conditions in paragraph 1.1, the Municipal supplies are sufficient for DPW residential needs.

1.2 IN AREAS WITHOUT FIRE HYDRANTS IN STREETS, OPERATIONAL FIRE BRIDGADES AND RELIABLE WATER SUPPLIES

Provide all the necessary fire hydrants on site and in the relevant buildings. **The shortfall in firewater flow shall be taken as equal to the total minimum required firewater flow as set out in paragraph 1.1 above, and on-site storage shall be provided, for this full flow.**
In addition, for residential areas of DPW works under this supply condition, provide:

Area classification in accordance with the Guidelines for Human Settlement Planning and Design (Red Book)	Public residential area	Minimum available fire water from Local Authority	Min required fire water flow for residential public building(s)	
			From hydrants installed in streets	From hose reels
	Military and Prison Residential areas with individual buildings of maximum gross			

Area classification in accordance with the Guidelines for Human Settlement Planning and Design (Red Book)	Public residential area	Minimum available fire water from Local Authority	Min required fire water flow for residential public building(s)	
			From hydrants installed in streets	From hose reels
	floor area:			
Low Risk Group 1 area	(i) > 200m ²	-	15l/s per hydrant from a minimum of 1 hydrant	0,5l/s per hose reel from a maximum of 3 hose reels
Low Risk Group 2 area	(ii) 100 – 200m ²	-	8,3l/s per hydrant from a minimum of 1 hydrant	-
Low Risk Group 3 & 4 areas	(iii) < 100m ²	-	5,8l/s per hydrant from a minimum of 1 hydrant	-

2. MINIMUM DURATION OF FIRE WATER FLOW SHORTFALL (IF ANY), FOR WHICH ON SITE STORAGE SHALL BE PROVIDED

Area classification in accordance with the Guidelines for Human Settlement Planning and Design (Red Book) and Area Fire Flow Duration	Public building installations	Minimum Fire Water Storage duration (h)	DPW storage classification for <u>building(s)</u>
High Risk Area (6h)	Military installations	6h	High risk
	Public administration building	4h	Moderate risk
Moderate Risk Area (4h)	Public administration building	4h	Moderate risk
	Magistrates Court	3h	Moderate to low risk group1
	Police Station	3h	Moderate to low risk group1
Low Risk Group 1 area (2h)	Police station		
	a) Without prisoner cells	1h	Low risk group 2
	b) With prisoner cells	2h	Low risk group 1
	Prison		
	a) ≤ 1000 prisoners	2h	Low risk group 1
	b) 1000 – 2000 prisoners	3h	Moderate to Low risk group1
	c) > 2000 prisoners	4h	Moderate risk
	Residential areas of DPW		
	a) Group cluster, town houses and schools	2h	Low risk group 1
	b) Normal housing	1h	Low risk group 2

Area classification in accordance with the Guidelines for Human Settlement Planning and Design (Red Book) and Area Fire Flow Duration	Public building installations	Minimum Fire Water Storage duration (h)	DPW storage classification for building(s)
Low Risk Group 2, 3 and 4 areas	Police station		
	a) Without prisoner cells	1h	Low risk group 2
	b) With prisoner cells	2h	Low risk group 1
	Prison		
	a) ≤ 1000 prisoners	2h	Low risk group 2
	b) 1000 – 2000 prisoners	3h	Low to moderate risk
	c) > 2000 prisoners	4h	Moderate risk
	Residential areas of DPW		
	a) Group-, cluster-, town houses and schools	2h	Low risk group 1
	b) Normal housing	1h	Low risk group 2

3. APPLICABLE MAXIMUM ON-SITE AND SITE-TO-STREET HYDRANT SPACING

Area classification in accordance with the Guidelines for Human Settlement Planning and Design (Red Book)	Public Building Installations	Maximum Hydrant Spacing	Maximum Distance of any point of building from a hydrant
High Risk Area	Military Installation	120m	60m
	Public Administration Building	120m	60m
Moderate Risk Area	Public Administration Building	180m	90m
	Magistrates Court	180m	90m
	Police Station	180m	90m
Low Risk Group 1, 2, 3 and 4	Police Station		
	a) Without prisoner cells	240m	120m
	b) With prisoner cells	180m	90m
	Prison		
	a) ≤ 1000 prisoners	160m	80m
	b) 1000 – 2000 prisoners	140m	70m
	c) > 2000 prisoners	120m	60m
	Residential areas of DPW		
	a) Group-, cluster-, town houses and schools	180m	90m
	b) Normal housing	240m	120m

4. MINIMUM ELEVATED DOMESTIC STORAGE

PUBLIC BUILDING	MIN REQUIRED STORAGE	REFERENCE CODE
Public Administration Buildings and Magistrates Courts		
a) In cities and towns with reliable and well maintained water reticulations	24h ADWF	SABS 0252 Table 11:12h – 24h
b) In other towns and rural areas with reliable gravity supplies	24h ADWF	SABS 0252 Table 11:12h – 24h
c) In towns and rural areas with pumped or unreliable supplies	48h ADWF	“Red Book” : Chapter 9: p26 48h
Police Stations		
(a) For reliable gravity supplies and in cities and towns with reliable and well maintained water reticulations	24h ADWF	SABS 0252 Table 11:12h – 24h
(b) For pumped or unreliable supplies	48h ADWF	“Red Book” : Chapter 9: p26 48h
Prisons		
a) Prison Buildings	48h ADWF	“Red Book” : Chapter 9: p26 48h
b) Associated residential group-, cluster-, town houses and schools	24h ADWF 24h – 48h ADWF	SABS 0252 Table 11:16h – 24h “Red Book” : Chapter 9: p26 24h-48h
(i) For reliable gravity supplies (ii) For pumped or unreliable supplies		
c) For other associated residential areas	No storage required 24h – 48h ADWF	SABS 0252 Table 11: none required “Red Book” Chapter 9 : p26: 24h – 48h
(i) For reliable gravity supplies (ii) For pumped or unreliable supplies		
Military Installations		
a) Aircraft maintenance, admin & air passenger terminals	24h 48h	“Red Book”: 24h – 48h “Red Book”: 48h
(i) For reliable gravity supplies (ii) For pumped or unreliable supplies		
b) Associated residential group-, cluster-, townhouses, schools, hospitals etc	12h – 24h ADWF 24h-48h ADWF	SABS 0252 Table 11: 16h – 24h “Red Book” : Chapter 9: p26 24h-48h
(i) For reliable gravity supplies (ii) For pumped or unreliable supplies		
c) For other associated residential areas	No storage required 24h-48h ADWF	SABS 0252 Table 11: none required “Red Book” : Chapter 9: p26 24h-48h
(i) For reliable gravity supplies (ii) For pumped or unreliable supplies		

5. MINIMUM ELEVATED FIRE STORAGE

PUBLIC BUILDING	MIN REQUIRED STORAGE	REFERENCE CODE
For each separate public admin building, magistrates court, prison building and military building exceeding 250m ² in floor area	9kl	SABS 0252 : Clause 7.4.2.4: 4,5kl – 9kl
For hospitals, educational institutions and where-ever a discrete fire installation is installed	9kl	SABS 0252 : Clause 7.4.2.4: 4,5kl – 9kl
For other residential buildings	None required	SABS 0400: Clause TT 34.1 (No hose reels required)

6. MINIMUM HEIGHT OF ELEVATED FIRE STORAGE

PUBLIC BUILDING	MIN HEIGHT	REFERENCE CODE
For all DPW buildings and two more storey on height and any single storey building with floor area exceeding 250m ² excluding normal residential buildings	Floor of tank to be placed at a level to obtain a residual pressure of not less than 70kPa at the highest hose reel when a minimum of 2 hose reels are operating simultaneously	SABS 0252 : Clauses 7.2.2.1: 70kPa and TT34.1 SABS 0400: Clause WW5.4: 2 hose reels simultaneously

7. MINIMUM FIRE HOSE REEL FLOW AND PRESSURE

DPW DEVELOPMENT	MIN FIRE HOSE REEL FLOW AND PRESSURE	REFERENCE CODE
For all Public buildings of two and more storeys in height and any single storey building with floor area exceeding 250m ² excluding normal residential buildings.	0,5 l/s @ 300kPa with a minimum residual pressure of 70 kPa at the highest hose reel when two hose reels are in full operation	SABS 0400: Clauses WW5.1: 0,5 l/s @ 300kPa and TT34.1 SABS 0252: Clause 7.2.2.1: 70kPa min at highest point with one hose reel in full operation.

8. FIRE HYDRANT BOOSTER REQUIREMENTS*

DPW DEVELOPMENT	REQUIREMENTS
For all Public buildings which do not require hydrants in the building in areas where a fully operational fire brigade is available and street hydrants are located in such a way that fire water can be boosted through the fire engine and fire fighters can reach all faces of the building with their normal equipment.	No booster connection is required

For Public building with FIRE HYDRANTS in the Building and where a fully operational fire brigade is available	Provide a booster inlet connection on the boundary connected to the building fire hydrants in accordance with the requirements of the local Fire Chief Officer
For Public buildings not served by an operational fire brigade but with a reliable water supply and pressures which do not drop below 300kPa	No fire booster connection will be required
For Public buildings not served by an operational fire brigade and with an unreliable water supply or minimum water pressures below 300kPa	Provide two booster pumps (one duty and one standby) from a ground level water storage reservoir. Connect the booster pumps to a diesel electric generating set. Each booster pump's capacity shall be sufficient to provide the calculated minimum design fire flow as set out in paragraph 1.1

9. FIRE HOSE REEL BOOSTER PUMPS*

DPW DEVELOPMENT	BOOSTER PUMP REQUIREMENTS
All Public buildings served by a reliable gravity water supply under a pressure which never drops below 300kPa and in which the hose reels are under the mains pressure	None required
All Public buildings with hose reels <i>that are</i> served by a water source with minimum pressures less than 300kPa.	Provide 2 hose reel booster pumps (one duty, one standby) with a capacity sufficient to boost a flow equal to the maximum number of hose reels simultaneously in operation to a minimum pressure of 300kPa.

10. SPRINKLER SYSTEMS*

Sprinkler systems shall be provided for any Public building falling within the category of Clause TT36.1 of SABS 0400 and the water requirement for the system shall be determined by a competent specialist in sprinkler systems.

* NOTE: All Fire Pumping Installations and Control Systems, shall comply with the "Fire Security" standards of the DPW.

11. THE PRINCIPLES IN THESE GUIDELINES ARE ILLUSTRATED IN THE FOLLOWING EXAMPLES

- 11.1 Police station in a "moderate risk" area of a city with fully operational fire brigade and street fire hydrant(s) enabling the fire engine to reach all parts of the police station. The water supply is reliable and the supply rate and pressures are in excess of that required for domestic and fire demands. (See following diagram 11.1)

Design:

- o Allow only for a domestic water storage tank with capacity equal to 24h ADWF for internal water disruptions.

- Firewater is always and immediately available from the municipal supply, and no firewater storage tanks are required.
- Allow on site for a fire hose reel flow from 3 hose reels directly connected to the municipal supply without a valve *on the site*.
- No fire hydrants, hydrant booster connection or hydrant booster pumps are required on site.
- No fire hose reel booster pumps are required.
- Shut off valve is provided on domestic water only for maintenance purposes.
- Domestic water tank can be situated on top of the building or on a stand higher than the building.
- Allowance is made to circulate the water through the tank by connecting three to four cisterns with the tank.
- An emergency valve (under control of the Police Station Chief) is installed on the domestic delivery line from the tank to supply water to the building during maintenance or other emergency situations.

11.2 Magistrates Court of 2 storeys in the business centre of town with fully operational fire brigade. There is however, only one street hydrant in the vicinity, which is not sufficient for use by a fire engine to extinguish a fire at any location of the building. Although the water source is sufficient and reliable, the water pressure drops at times below 300kPa. The minimum water head at the site is 24m and at least 7m above the highest floor level. (See following diagram 11.2)

Design:

- Allow for domestic storage tank of 24h ADWF and 9kl of firewater storage on a stand. The bottom of the tank shall be at least 7m plus the delivery friction head loss above the highest floor level and the top water level in the tank shall not be higher than 24m above the level of the water supply main.
- No ground level fire storage reservoir is required.
- Provide fire hydrants around the building at a maximum distance of 180m apart with no part of the building further than 90m from a hydrant. Say 3 additional hydrants are required.
- Provide a fire brigade booster connection on the boundary of the site in accordance with the local municipalities requirements for boosting both the fire hydrant and hose reel supplies.
- Connect the emergency domestic storage via an emergency valve to the buildings domestic supply and to 3 to 4 cisterns for circulating purposes.
- Connect the emergency fire supply to the hose reels via a reflux valve hanging normally open and also to the fire hydrant loop.
- Provide a *reduced pressure backflow preventer (RPBP) valve* in the supply line to prevent emergency stored water draining out of the site
- Design the fire loop for a flow of 20l/s from any 4 hydrants and the simultaneous flow from the hose reels in any division of the building under the maximum pressure supplied by the Local Authority's fire engines.

11.3 Police Station with prisoner cells in a rural area with no fire brigade service and street fire hydrants but with reliable and well maintained gravity water supplies with sufficient flows for domestic and fire fighting uses. The minimum water head in the mains of 25m is sufficient for domestic purposes but insufficient for fire hose reels. The police station will have an administration staff of 40 and 80 prisoners in cells. (See following diagram 11.3)

Design

- Allow for an emergency tank with 24h ADWF for domestic storage and 9kl min for fire hose reel storage on a tank stand. Bottom of tank shall be more than 7m plus delivery friction losses above the level of the highest hose reel on the top storey and the top water level of the tank shall be not more than 25m above the level of the main supply pipe.
- Provide a fire hydrant ring main with fire hydrants spaced at 180m maximum. The police station will require 2 hydrants of which any one can be used for fire fighting.
- Provide a booster pump installation for the hydrants (duty plus standby), connected to a diesel-electric generating set, for boosting both the fire hydrant ring and the hose reels.
- Supply water for domestic use directly from the main with an emergency supply from the tank via a manual valve under the control of the Police Station Chief. *The reduced pressure backflow valve shall prevent emergency water escaping out of the site.*
- Supply an emergency fire supply from the tank via a reflux valve (normally open) to the hose reels. The architectural division specified 4 hose reels for the police station. A maximum of three of these will be used simultaneously.
- Connect the hose reel supply also to the booster pump installation.
- The emergency tank shall be kept full under the mains pressure.
- As the water supply is reliable, no ground level fire water reservoir is required.
- The water storage and fire water requirement are calculated as follows:

Elevated domestic storage : Administration : 40 @ 70 l/p/d	=	2,8kl
(24h) Prisoners : 80 @ 200 l/p/d	=	16,0kl
Total	=	18,8kl
Elevated fire storage :	=	9,0kl
Total elevated storage in tank on stand	=	27,8kl

- The water supply required by the booster pump installation, is calculated as follows:
Min Fire Design Flow as per table = 20,0l/s (one hydrant)
+ 3 hose reels max simultaneously 3 x 0,5l/s = 1,5l/s = 1,5l/s
Design fire flow is therefore = 21,5l/s

- 11.4 Prison in rural area with no fire brigade and street fire hydrants, insufficient water supplies for fire fighting and with water pressures dropping below 300kPa. Water supply and/or pressures are sufficient for the domestic requirements of the prison but are unreliable. The prison will have a prisoner population of 3000 and an average water requirement of 378 l/pr/d (excluding fire). The minimum mains water pressure is 26m water head. A maximum of 8 fire hose reels have been installed in any building. (See following diagram 11.4)**

Design:

- Provide a ground level fire hydrant storage reservoir connected to a booster pump set (duty and standby) and a diesel electric generating set.
- Provide a fire hydrant ring main with fire hydrants spaced at 120m centres with no hydrant further than 60m from any point of a building to be protected. Nine hydrants will be required of which no more than 4 will be operated simultaneously.
- Provide a storage tank on a stand with 48h ADWF storage for domestic purposes and 9kl fire hose reel storage.
- Provide *hydrant and hose reel* booster pump sets (duty and standby), *plus diesel electric generating set* automatically boosting the fire *hydrant loop and hose reels* when any hose reel in a *building* is operated.

- The necessary emergency elevated tank circulation loop and pipework shall also be provided as before.

- The elevated storage is calculated as follows:

Elevated domestic storage
 $= 2 \text{ days} \times 3000 \times 150 \text{ l/d}$ $= 900 \text{ kl}$ (average consumption reduced due to low emergency pressures and/or flow throttling)

Elevated fire storage $= 9 \text{ kl}$

Total elevated storage $= 909 \text{ kl}$ (or 13m x 12m x 6m modular tank on stand)

- The ground level fire water storage tank is calculated as follows:

Minimum design fire flow $= 4 \times 20 \text{ l/s}$ $= 80 \text{ l/s}$

For a maximum of 8 hose reels

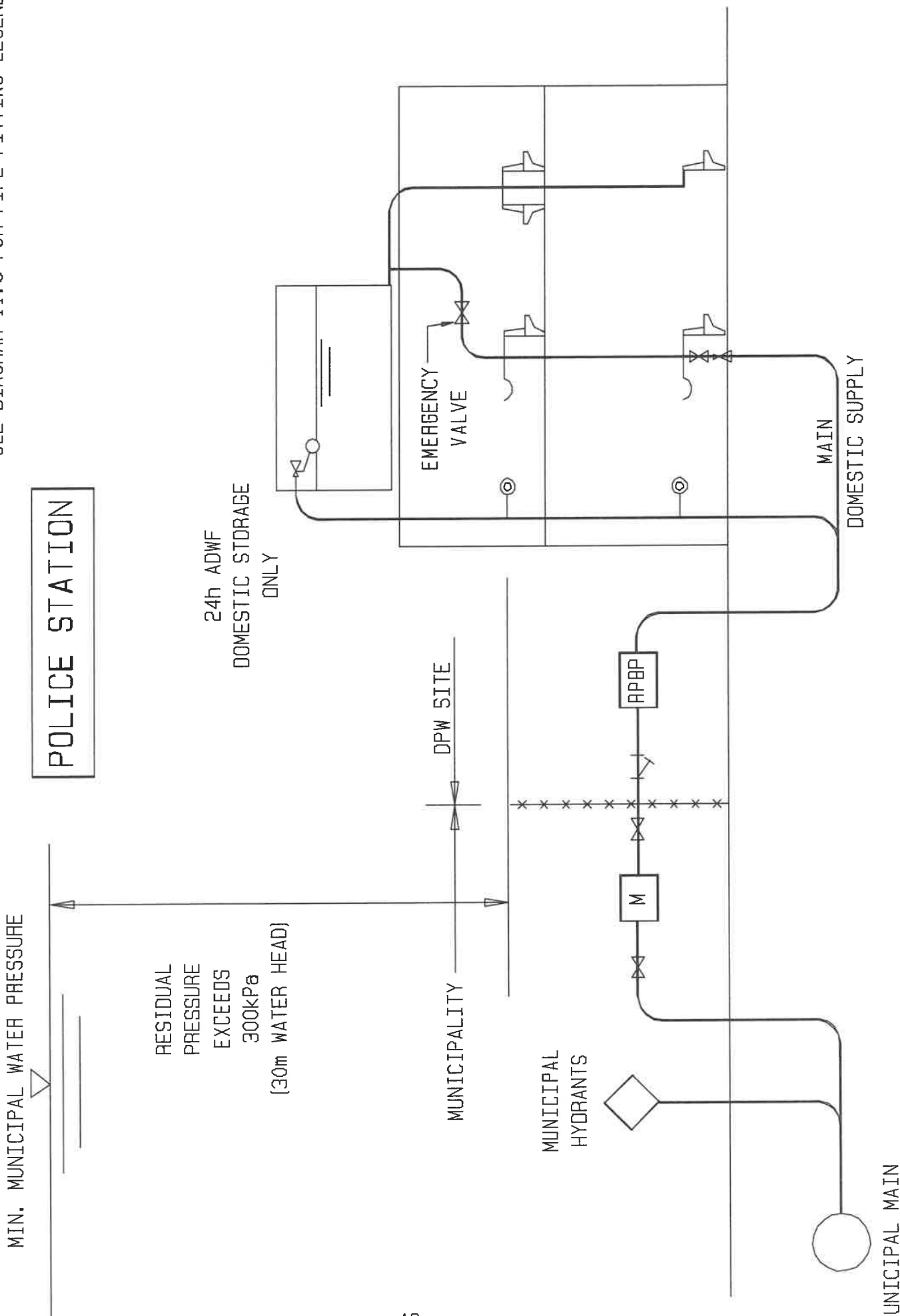
operating simultaneously,

the flow required $= 8 \times 0.5 \text{ l/s}$ $= 4 \text{ l/s}$

Therefore design fire flow **$= 84 \text{ l/s}$**

Minimum ground level firewater storage

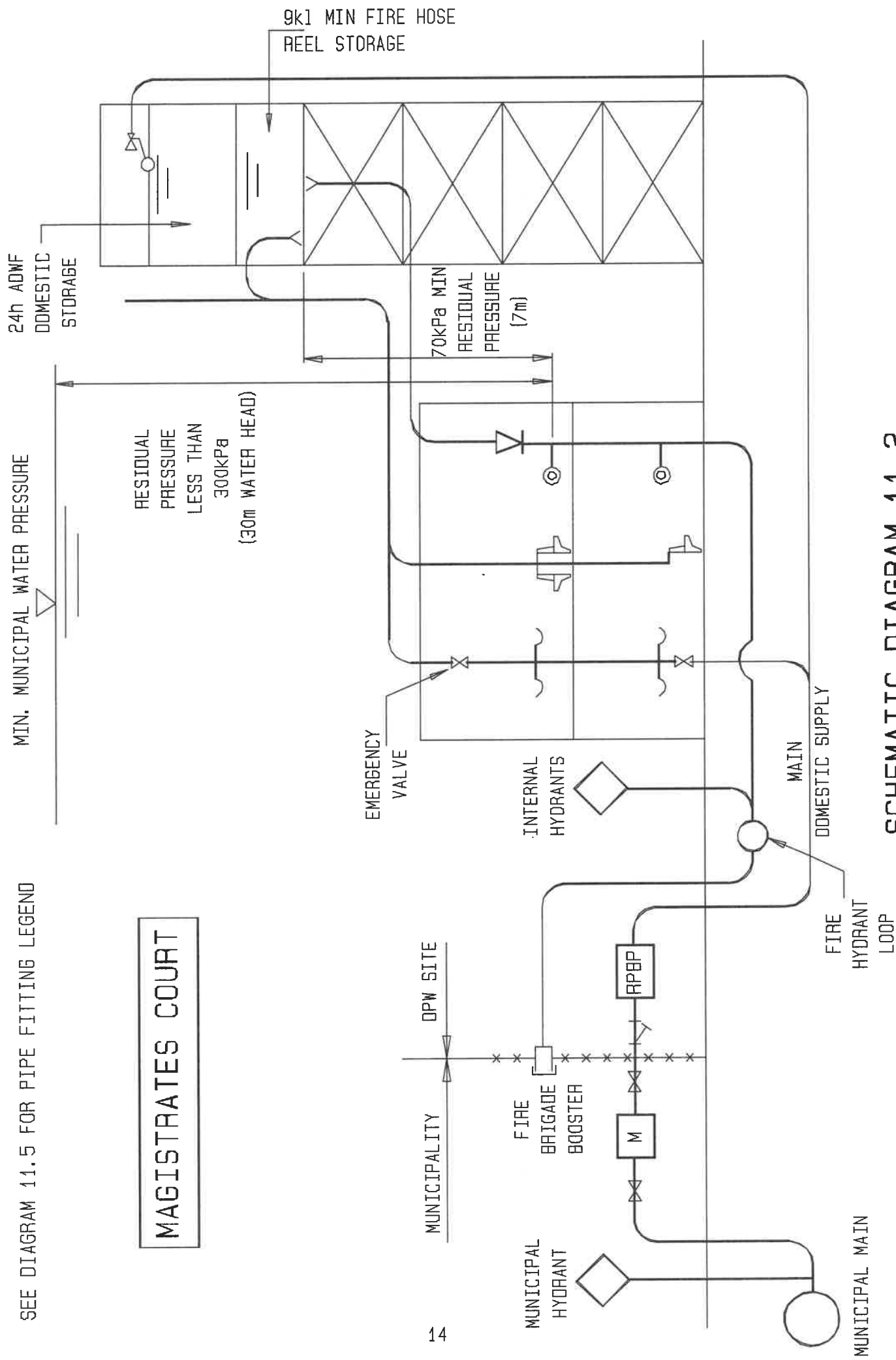
required $= 4 \text{ h @ } 84 \text{ l/s}$ $= 1210 \text{ kl}$ or 17m dia x 5.3m deep reservoir



SCHEMATIC DIAGRAM 11.1

SEE DIAGRAM 11.5 FOR PIPE FITTING LEGEND

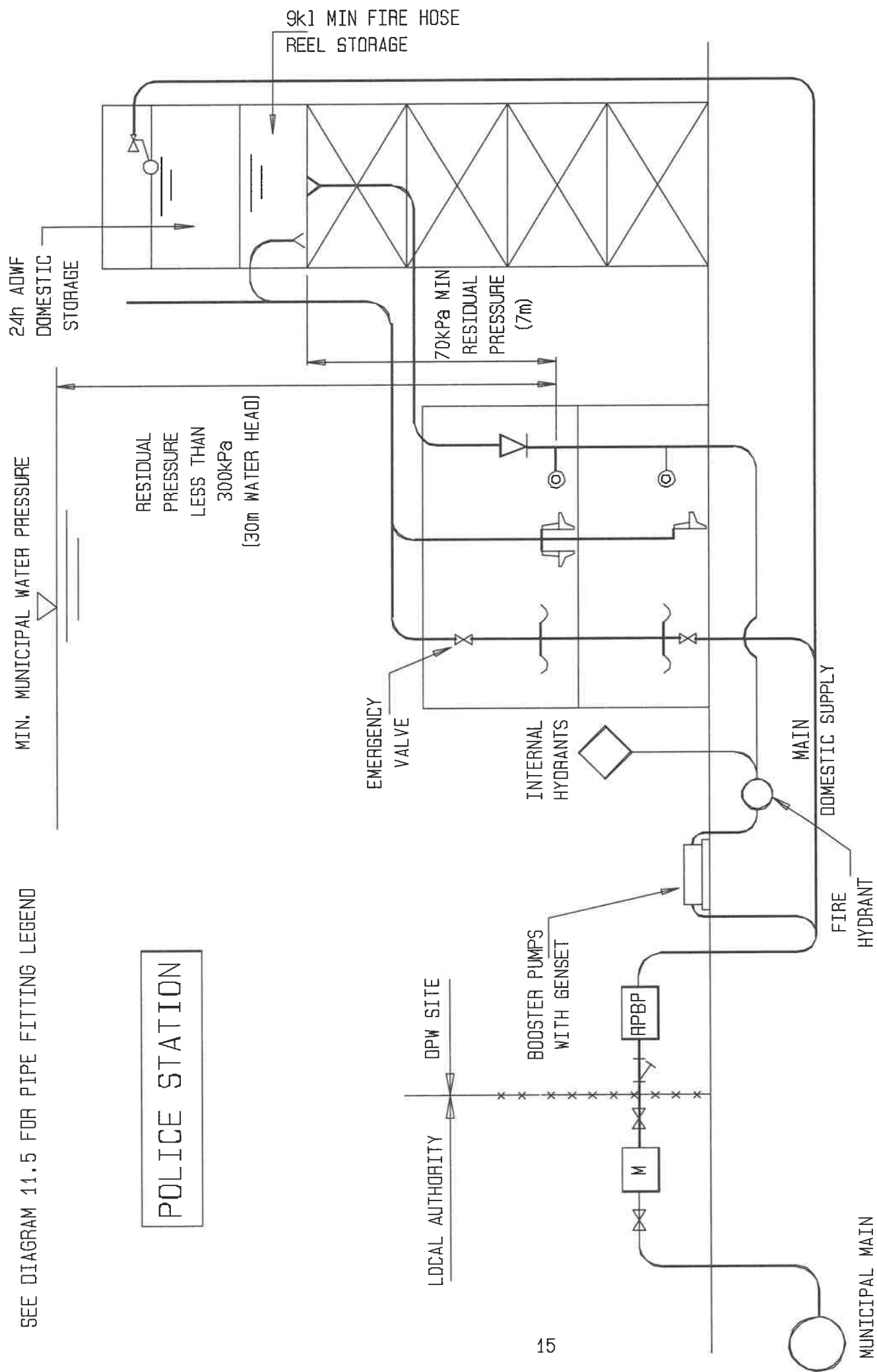
MAGISTRATES COURT



SCHEMATIC DIAGRAM 11.2

SEE DIAGRAM 11.5 FOR PIPE FITTING LEGEND

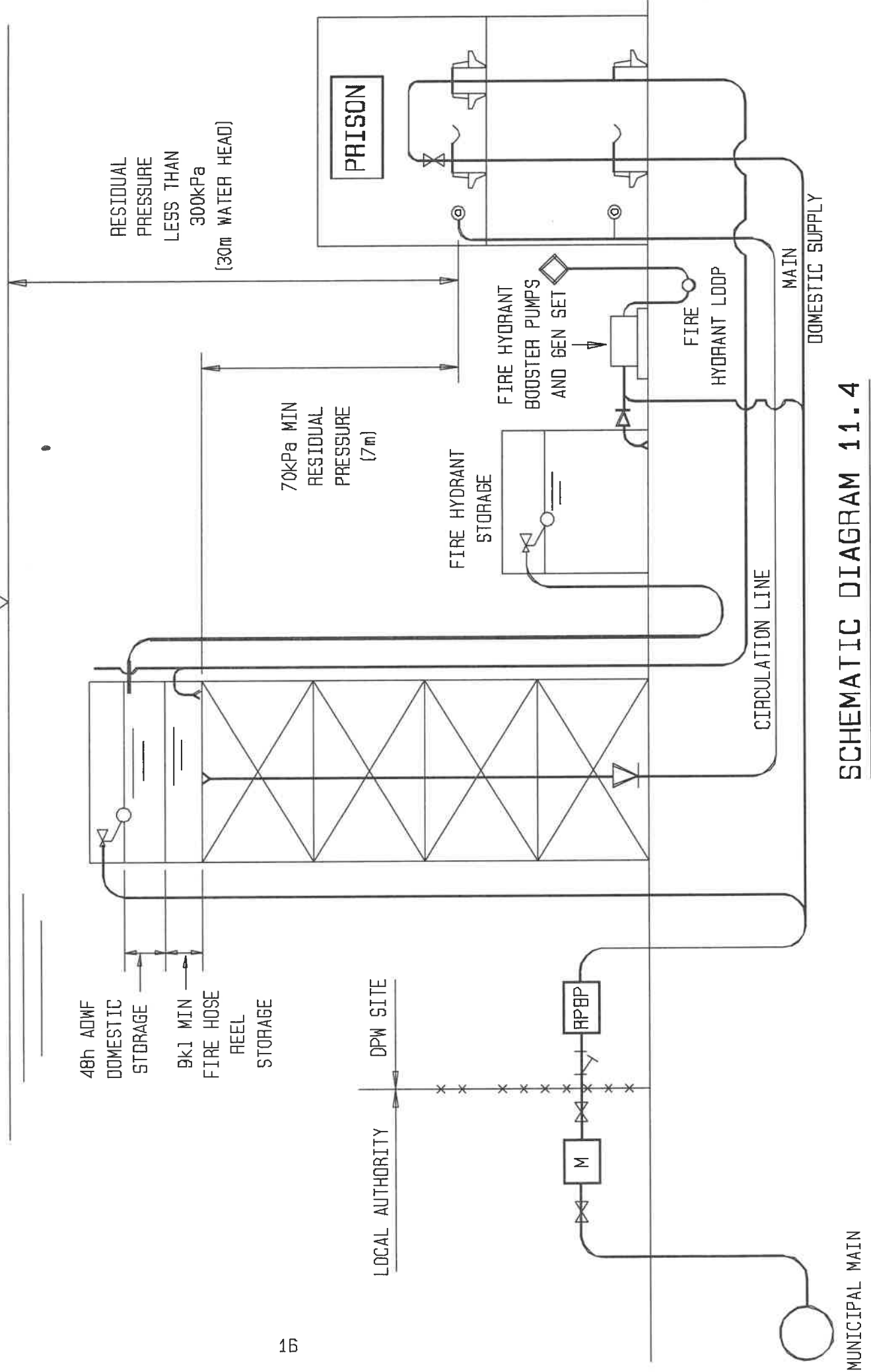
POLICE STATION



SCHEMATIC DIAGRAM 11.3

SEE DIAGRAM 11.5 FOR PIPE FITTING LEGEND

MIN. MUNICIPAL WATER PRESSURE



SCHEMATIC DIAGRAM 11.4



TOILET (CISTERN)



WASH HAND BASIN



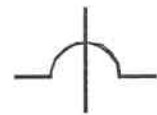
WATER METER



FLOAT VALVE



FIRE HOSE REEL



PIPE CROSSING



REDUCED PRESSURE BACKFLOW PREVENTER



STRAINER



PRESSURE REDUCING VALVE



MAINTENANCE, ISOLATION OR EMERGENCY VALVE



FIRE HYDRANT

PIPE FITTING LEGEND

SCHEMATIC DIAGRAM 11.5



DEPARTMENT OF PUBLIC WORKS

FIRE SECURITY

STANDARD TECHNICAL SPECIFICATION FOR AN INERT GAS AGENT FIRE EXTINGUISHING SYSTEM

STS 9
REF: FPO 4E
JANUARY 1999

STANDARD SPECIFICATION
FOR
AN INERT GAS AGENT FIRE EXTINGUISHING SYSTEM

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1. SECTION 1: GENERAL REQUIREMENTS

1.1 NOTICE

This Standard Specification forms part of, and shall be read in conjunction with, the Department's Supplementary Specification pertaining to a specific Inert Gas Agent fire extinguishing installation/service.

Any reference to "Contractor" or "Sub-contractor" shall be interpreted as the successful tenderer appointed to execute the contract of works specified in the Department's Supplementary Specification.

Copyright of this, and associated documents, vests with the Department of Public Works.

1.2 SCOPE AND OBJECTIVE

This Standard Specification shall apply to any fire protection or extinguishing installation containing an Inert Gas Agent, in accordance with the Standard on Clean Agent Fire Extinguishing Systems - NFPA 2001 latest edition, as issued by the National Fire Protection Association of the USA as extinguishing medium.

The Inert Gas Agent shall contain as primary components:

- Nitrogen (N₂), as well as one or more of the following gases:
- Helium (He)
- Neon (Ne)
- Argon (Ar)

The Inert Gas Agent may further contain Carbon Dioxide CO₂ as a secondary component.

The exact constitution and constituent tolerance of the Inert Gas Agent shall be in accordance with NFPA 2001 latest edition. Table 2-1.2(b) - Inert Gas Clean Agent Quality Requirements.

The objectives of an Inert Gas Agent discharge into any protected space shall be:

- Reduction of the oxygen (O₂) concentration in the protected space, by virtue of displacement of a significant part of the atmosphere, to a level which will not sustain fires of Classes A, B or C.
- To limit the reduction in oxygen concentration to a level which will still sustain human life at a fairly low rate of activity.
- Where Inert Gas Agents containing carbon dioxide (CO₂) are concerned, to limit the increase in CO₂ concentration in the protected space to a level which will not cause any related effects of toxicity in persons of reasonable health.

This Standard Specification shall apply to engineered fixed total flooding installations. This Standard Specification shall apply to systems with storage pressures of 150Bar to 200Bar. Systems with storage pressure lower than 150Bar shall not be acceptable. Where system storage pressure exceeds 200Bar, such system shall be suitably rated for safe operation at such higher pressure.

1.3 SYSTEM APPROVAL AND DESIGN RESPONSIBILITY

Every Inert Gas Agent installation shall comply with either of the following:

1.3.1 System Approval by an Approved Body

The entire system offered to the Department of Public Works, including physical equipment, as well as design algorithms and software, shall have complete, non-exclusive, system approval by a standards organisation or certification body acceptable to the Department of Public Works, such as

- < South African Bureau of Standards (SABS)
- < Underwriters Laboratory (UL) - United States of America
- < Factory Mutual Research Corporation (FMRC) - United States of America
- < Verband der Schadenversicherer (VdS) - Germany
- < Germanischer Lloyds - Germany
- < Loss Prevention Certification Board (LPCB) - United Kingdom
- < Lloyds Register - United Kingdom
- < Det Norske Veritas - Norway/Sweden

Or other body approved by the Department of Public Works from time to time.

Proof of compliance with this requirement shall be by means of certified copies of the original certificates.

1.3.2

System Design by Competent Individual

In cases where no system approval exists, the entire system offered to the Department of Public Works, including physical equipment, as well as design algorithms and software, shall be designed by a South African registered Professional Engineer, or other party acceptable to the Department.

In either case, such a design shall form part of an approved, integrated design, manufacture and testing process in compliance with ISO9001. Proof of ISO9001 certification shall be provided to the Department

Furthermore, every item of equipment shall carry individual approval by a body acceptable to the Department, such as:

- < South African Bureau of Standards (SABS)
- < Underwriters Laboratory (UL) - United States of America
- < Factory Mutual Research Corporation (FMRC) - United States of America
- < Verband der Schadenversicherer (VdS) - Germany
- < Germanischer Lloyds - Germany
- < Loss Prevention Certification Board (LPCB) - United Kingdom
- < Lloyds Register- United Kingdom
- < Det Norske Veritas - Norway/Sweden

Or other body approved by the Department of Public Works from time to time.

The design of the fire protection layout detailed in the Supplementary Specification shall be done as part of an ISO9001 certified design program. The technical interface as required by the ISO9001 process, shall be the Engineer.

Final design verification, as called for by ISO9001, shall be included in the scope of works unless otherwise specified in the Supplementary Specification.

1.4

COMPLIANCE & STANDARD SPECIFICATIONS

Unless specifically noted otherwise in the Supplementary Specification, all aspects of any Inert Gas Agent installation shall comply with the following regulations:

- < Occupational Health and Safety Act (Act 85 of 1993, as amended) with Regulations.
- < National Building Regulations Act of 1977 (SABS 0400 -1990) as amended.
- < Local Municipal or other by-laws as applicable.
- < Any applicable legislation imposed by any local or other authority.

Unless specifically noted otherwise in the Supplementary Specification, all aspects of any Inert Gas Agent installation shall meet or exceed the following specifications:

- < NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems - Latest Edition, as issued by the National Fire Protection Association of the USA.
- < Department of Public Works F.P.O./82/5E Standard Technical Specification for an

- Automatic Fire Alarm System - Latest Revision.
< Department of Public Works F.P.O.9E Standard Specification for Security Equipment - Latest Revision.

1.5 LIABILITY

All liability with respect to safety or other legislation regarding transport from manufacturer's premises, erection, storage on site, operation, etc. of any Inert Gas Agent installation shall rest with the Contractor until such time as the Department of Public Works has taken first delivery of such installation, and the Department or its representative has confirmed acceptance of such first delivery in writing.

1.6 STANDARD MEASURES

All dimensions, masses, volumes, etc. indicated on any drawings, schedules, submittals or other, shall be in accordance with the SI system.

1.7 WORK BY OTHERS

- All work necessary for successful completion of an installation shall be deemed to be included in the scope of works, except where it is specified in the Supplementary Specification as "by others".

1.8 DRAWINGS AND SUBMITTALS

Any drawings issued as part of the Department's Supplementary Specification are not working drawings, but are in essence schematic, and do not necessarily show the exact position, size, quantity or details of equipment construction, or pipe and other routes.

Tenderers should satisfy themselves that any equipment offered can indeed be accommodated as shown on the schematic drawings, without obstructing access for maintenance, repairs, or removal.

The successful tenderer shall submit Contractor's drawings, design calculations, and equipment samples, unless otherwise instructed by the Engineer. Drawings shall be prepared at the Contractor's expense, and shall be to a scale not less than 1:50 for plan layouts, and 1:20 for details. Drawings shall be submitted in sets of four to the Department or Engineer.

The Contractor shall at the time of submittal specifically point out in writing to the Department any deviations from this document or the Supplementary Specification. The Department may, at its discretion, require amendment and resubmittal prior to approval. Where items not requested by the Department are adjusted during amendment, these shall be pointed out in writing by the Contractor when resubmitting. No work shall commence until the relevant drawings or other documentation has been approved.

In the event of a Contractor failing to timeously provide equipment samples or final workshop drawings for approval, or if he fails to provide these at all, he shall be deemed to commence with any equipment or materials purchasing, manufacturing or installation or any other work at his own risk, and neither the Department, nor the Engineer shall be liable for any additional costs incurred to execute the contract works to the satisfaction of the Department and the Engineer, whether such costs be for redesign, remanufacture, scrapped material or equipment, or whatever, and regardless of whatever the reason/s for such failure.

Approval by the Department or Engineer of drawings or design calculations submitted by the Contractor shall in no way relieve the Contractor of his liability to complete the works in accordance with the requirements of the contract documents, and to the satisfaction of the Department and Engineer.

1.8.1 Builders Work Drawings

If required by the Supplementary Specification, the successful tenderer shall submit builders work drawings of all work by others required for this service within the time period specified

in the Department's Supplementary Specification. These drawings shall be dimensioned, and include the following:

- < All builders items eg. bases, foundations, brickwork and concrete openings, cast-in items. etc.
- < Electrical items such as chasing or recessed conduiting, electrical feeds, isolator or wall socket positions and rating, fire outputs if applicable, etc.
- < Plumbers work if applicable.

1.8.2 Design Calculations

The successful tenderer shall submit for perusal by the Engineer copies of his detailed design calculations within the time period specified in the Department's Supplementary Specification. These shall include at least the following:

- < System sizing calculations. Design concentration shall be clearly indicated for each and every zone or space, and whether such spaces are normally occupied or normally unoccupied.
- < Distribution system detail design. All discharge pressures, both upstream and downstream of the main orifice shall be clearly indicated, together with proposed nozzle and pipe sizes, specifications, and allowable working pressures.
- < Final discharge quantities for every protected space, design concentrations. 95% discharge time.

1.8.3 Working Drawings

The successful tenderer shall submit for approval copies of his complete working drawings within the time period specified in the Department's Supplementary Specification. As a minimum, these shall include the following:

- < Plan layout of all equipment and distribution systems incorporating the latest architectural and structural layouts, to a scale of 1:50.
- < Where any lights, air conditioning diffusers, grilles, public address systems or other ceiling mounted devices, as well as any ducting, piping, cable trays, trunking or other equipment which may interfere with the installation are to be installed, or are already installed in the same spaces, the extent and positions of these shall be clearly indicated on working drawings.
- < Sections/elevations to a scale of 1:20 or larger indicating equipment details such as bracketing arrangements, enclosure details, construction details where these are not precisely as per the standard and supplementary drawings.

1.8.4 Electrical and Controls Schematics

The successful tenderer shall submit for approval copies of his electrical and controls schematics within the time period specified in the Department's Supplementary Specification. As a minimum, these shall include the following:

- < Power supply single line diagrams indicating size of incomer feed, feed isolator requirement, standby batteries, UPS feeds, switchgear, fault levels, etc.
- < Controls schematic indicating interfacing to detection system, details of actuation, detection alarms, and safety devices, etc.
- < General arrangement drawings of all distribution boards, control panels and annunciator panels.

Wiring diagrams shall include numbers and sizes of conductors. The numbers of terminals and Corresponding conductors shall agree.

1.8.5 Equipment Samples

If required in the Supplementary Specification, samples of equipment, such as discharge valves, storage cylinders, actuation devices, direction valves, etc. proposed by a Contractor

shall be handed over to the Engineer for approval. The Contractor shall ensure that these are handed over in good time. i.e. at least 2 weeks before ordering or installation of every respective item commences.

1.8.6 As-Built Drawings and Schematics

As built drawings shall be handed over to the Department unless otherwise specified in the Department's Supplementary Specification. Draft Operational & Maintenance manuals shall be handed over at least 2 weeks prior to first delivery.

1.9 MATERIALS AND WORKMANSHIP

All equipment forming part of the works shall be of excellent quality with regard to material and finish, and of a standard acceptable by the Department. The Contractor shall employ the services of skilled personnel who are familiar with the high standard of workmanship required by the Department - Contractors are reminded that "normal industry practice" may not be acceptable by the Department.

1.10 DEVIATION FROM SPECIFICATION

Where a tenderer proposes any changes to the Departmental layout, these changes shall be marked in RED on the set of drawings returned with the tender, and offered as an alternative to the Departmental layout, and further detailed in a covering letter. The main tender shall nevertheless be to the letter of this specification and the Departmental layout.

1.11 PROGRAMMING OF WORK

The Contractor shall submit a program of works, in the form of a bar chart, within the time period specified in the Department's Supplementary Specification. This program shall make due allowance for the main building contract, if applicable, or any other activities which may require detailed scheduling to avoid delays or clashing of trades on site. The program shall include the following as a minimum requirement:

- < Design stage
- < Procurement of equipment
- < First & final fixes - distribution system
- < First & final fixes - electrical & controls
- < Milestone events such as delivery of storage cylinders to site, any testing or inspections by relevant
- < Authorities.
- < Commissioning
- < Handover

1.12 PERFORMANCE TOLERANCE

The Contractor shall at the time of first delivery hand over to the Department a certificate of confirmation that he guarantees actual Inert Gas Agent concentration of every protected space to be in accordance with the tolerances set out in SECTION 2 of this document. A copy of this certificate shall be bound into every Operation & Maintenance Manual, and the original shall be handed over to the Engineer or Department.

This certificate of confirmation shall include:

- < Clear description of every protected space
- < Volume of every protected space
- < Total volume of agent piped to protected space
- < Inert Gas Agent design concentration
- < Guaranteed maximum Inert Gas Agent concentration
- < Guaranteed minimum Inert Gas Agent concentration

1.13 NOTICES & SIGNAGE

All notices and signage associated with an Inert Gas Agent installation shall be supplied and installed as part of the installation. This shall include any temporary signage, which may be required.

1.14 COMMISSIONING & TESTING

Commissioning shall be done in a co-ordinated way in accordance with the requirements set out by the manufacturer of the equipment, and with the provisions of NFPA 2001.

The proper operation of the installation shall be demonstrated to the Engineer and a representative of the Department.

The Contractor shall bear the cost of all consumables, testing equipment, materials or extinguishing agent required for demonstration purposes.

1.15 GUARANTEE

The entire works shall be guaranteed by the Contractor for a period of no less than 12 months from date of first delivery. During this time, the Contractor shall repair or replace any defective equipment or materials, other than that obviously damaged by others, at his expense.

The Contractor shall maintain the entire works during this period, and he shall perform routine maintenance at his expense, inclusive of any consumables or incidental costs.

1.16 INSPECTIONS AND TEST CERTIFICATES

The Contractor shall obtain all required test certificates, and organize all necessary inspections, on behalf of the Department of Public Works as part of his scope of works. These shall include all certificates or inspections with regard to pressure testing of storage cylinders and other equipment as required in terms of Occupational Health and Safety Act or other as applicable.

1.17 APPLICATION FOR INSTALLATION & COMMISSIONING

Where any inspections or approvals of equipment or installations by inspection authorities or other are required before transport, erection, commissioning, operation, or any other action required for successful completion of the works may take place, these approvals or inspections shall be obtained by the Contractor.

1.18 DOCUMENTATION TO BE HANDED OVER

Refer to Clause 6.1 - Documentation Schedule, which forms part of this document.

The Contractor shall hand over to the Department at the indicated times all required documents as detailed at the required stages as indicated.

1.19 SERVICE ACCESS

The Contractor shall ensure that adequate access for service and removal of all items of equipment is allowed for.

1.20 SITE CLEARING

All scrap or loose materials associated with work done as part of this scope of works shall be removed from site by the Contractor before acceptance of first delivery by the Department.

2. SECTION 2: SYSTEM DESIGN

2.1 APPLICABILITY

This Standard Specification shall apply to any fire extinguishing installation containing an Inert Gas Agent, as described elsewhere in this document.

All Inert Gas Agent installations shall be engineered fixed full flooding systems.

Application of any Inert Gas Agent shall be limited to:

- < Class A surface and deep seated fires
- < Class B flammable liquid fires involving combustion of acetone, heptane, methane, or propane
- < Class C energized electrical equipment fires, e.g. in computer rooms, control rooms, transformer rooms, substations, plantrooms containing rotating equipment, pumps, motors. etc.

Inert Gas Agents are not applicable where the following types of fires are involved, and these fires shall be excluded from their application:

- < Class D combustible metal fires such as those involving magnesium, sodium, potassium, titanium, zirconium, etc.
- < Chemicals, substances, or devices containing oxygen rendering them capable of sustaining their own combustion, such as cellulose nitrate and other explosives, incendiary devices. etc.
- < Metal hydrides

Installations shall utilise an automatic fire detection system approved by the Department in line with the Departmental Standard Specification for Fire Detection Systems, and as detailed in this document and the Department's Supplementary Specification. Manual activation systems shall be allowable if called for in the Supplementary Specification.

2.2 DESIGN CODE

Any Inert Gas Agent installation shall be designed, erected and commissioned in accordance with or exceeding the following specifications, in order of preference:

- < Department of Public Works Supplementary Specification.
- < Department of Public Works Standard Specification for Inert Gas Agent Fire Extinguishing Systems (this document).
- < NFPA2001 Standard on Clean Agent Fire Extinguishing Systems - latest edition.
- < Manufacturer's specifications - latest edition.

Of these, the Departmental Supplementary Specification shall take preference over any other. Therefore, where anything contained in any of the Departmental Standard Specification (this document), NFPA2001, or the manufacturer's specification, is at variance with the Departmental Supplementary Specification, then the requirements of the Departmental Supplementary Specification shall take preference.

Any conflicts shall be referred to the Department for resolution before any action is taken.

2.3 PRELIMINARY DESIGN

The design as detailed in the Departmental Supplementary Specification with accompanying drawings is a preliminary design intended only to outline the scope of the works for tender purposes. Such a design, however detailed, shall under no circumstances be used as a final

layout for any Inert Gas Agent installation.

2.4 DETAILED DESIGN

Refer to clause 1.8.2 of this document.

The successful tenderer shall submit detailed design calculations of all aspects of every Inert Gas Agent installation. This shall include all aspects of an Inert Gas Agent installation as detailed in the design codes and specifications applicable.

It shall be assumed that any tenderer is completely familiar with the requirements of the applicable codes and standards as mentioned above, and that his design shall comply with all requirements of these, whether or not such requirements are specifically mentioned in this document or the Departmental Supplementary Specification.

2.4.1 Design by Competent Individual

Refer to clause 1.3 of this document.

2.4.2 Design Measurement

Exact dimensions of spaces shall be measured on site. Where this is not possible because building works have not been completed, exact dimensions shall be taken off architectural layouts. Under such circumstances, the Contractor shall verify before submittal of detail design that these dimensions have not changed.

2.4.3 Fire Divisions and Discharge Zoning

The Inert Gas Agent protection arrangement shall be designed in accordance with the fire divisioning of the protected area.

Unless otherwise specified in the Supplementary Specification, every individual protected space shall be served by a separate Inert Gas Agent protection system, which is capable of functioning in isolation from any other system. As a guideline, the following would constitute a **protected space**:

- < A room or space constituting a fire division as intended by the National Building Regulations, and with no or few uncloseable penetrations in the envelope.
- < A room or space enclosed by concrete slabs, masonry walls, drywall partitioning, or other physical barrier, with no or few uncloseable penetrations in the envelope, which is not necessarily a fire division, but which is indicated as a separate protected space in the Supplementary Specification.
- < A combination of subdivisions such as access floor voids, occupied zones over, and ceiling voids over, which all form functional part of the same space, even though separated by physical barriers.
- < A collection of functionally similar adjacent spaces that require combined gas discharge in order to achieve adequate protection against fire.

The Inert Gas Agent protection arrangement of any protected space shall be designed to effect simultaneous discharge of Inert Gas Agent in all parts of that particular protected space. If such a protected space contains subdivisions separated by any physical barrier, such as an access floor or ceiling, the Inert Gas Agent distribution system shall be designed to achieve a homogenous concentration of extinguishing gas in all parts of the space.

If the Supplementary Specification calls for a single Inert Gas Agent protection system to cover multiple spaces that would normally constitute separate protected spaces, such a protection system shall be designed to effect a single simultaneous discharge into all separate spaces. If the Supplementary Specification also calls for individual zoned discharge into the separate spaces, the distribution system shall be designed in accordance with clause 2.4.10 of this document.

2.4.4

Design Concentration

Design concentration shall depend on the nature and quantity of fuels contained in a protected hazard, as indicated in the Departmental Supplementary Specification.

Where Class B flammable liquid fires are concerned, and conditions exist which may result in subsequent reflash of a fire or explosion after agent discharge, ie:

- < where sufficient fuel quantity is allowed in the protected space to achieve average concentration equal or in excess of the lower flammability limit. AND
- < where, before agent discharge, ambient or fuel temperature is such that it would render the fuel volatile enough to reach lower flammability limit, or, where the detection system would permit a rate of temperature rise before extinguishing the fire which would cause the fuel to reach lower flammability level,

then the design concentration shall be the inerting design concentration applicable to the specific fuel contained in the protected space. Where flammable liquids cannot cause reflash or explosion, the design concentration shall be the flame extinguishing design concentration.

Inert Gas Agent minimum design concentrations for different classes of fire shall be as follows, unless otherwise stated in the Departmental Supplementary Specification:

Class A surface fires:	37.5%
Class A deep seated fires:	As tested in accordance with NFPA 2001
Class B flammable liquids - flame extinguishing concentrations:	
Acetone	In accordance with NFPA 2001
Heptane	In accordance with NFPA 2001
Methane	In accordance with NFPA 2001
Propane	In accordance with NFPA 2001
Other	As tested in accordance with NFPA 2001 or by an ISO9001 supplier
Class B flammable liquids - inerting concentrations:	
Methane	In accordance with NFPA 2001
Propane	In accordance with NFPA 2001
Other	As tested in accordance with NFPA 2001 or by an ISO9001 supplier
Class C energised electrical equipment fires:	37.5%

Where any hazard contains a combination of Class B flammable liquid fuels, then the Inert Gas Agent protection system shall be designed for the fuel rendering the highest design concentration, unless the actual mixture has been tested in accordance with NFPA 2001.

For Class B flammable liquid fuels not listed above, the following shall apply:

- < Flame extinguishing design concentration shall be the actual flame extinguishing concentration, obtained from reliable cup burner tests by an approved body to NFPA 2001, plus a 20% safety factor, all in accordance with NFPA 2001. Where reliable cup burner test data is not available, actual flame extinguishing concentrations obtained by means of full scale testing may be substituted. Such full scale testing shall be performed by an approved body, and as a minimum be in accordance with the fire test requirements of US Underwriters Laboratory UL1058 - Standard for Safety Halogenated Agent Extinguishing System Units - or other equivalent approved testing standard.
- < Inerting design concentration shall be the actual inerting concentration obtained from testing plus a 10% safety factor. Testing of inerting concentration shall be performed by an approved body, and shall be in accordance with the enclosed sphere explosion testing procedure for inerting concentration prescribed in NFPA 2001, or other equivalent procedure.

2.4.5

Design Concentration Tolerance

The Contractor shall make provision in his design so that actual concentration of Inert Gas Agent during and after agent discharge in every protected space is within the following performance tolerances, unless otherwise stated in the Departmental Supplementary Specification:

- < Normally unoccupied spaces - Inert Gas Agent concentration within $\pm 5\%$ of design
- < Normally occupied spaces, which would under normal circumstances be evacuated before discharge - Inert Gas Agent concentration within $\pm 5\%$ of design, with maximum concentration not exceeding 52%, corresponding to the Lowest Observable Adverse Effect Level in accordance with NFPA2001. unless otherwise specified in the Department's Supplementary Specification
- < Normally occupied spaces, which may under normal circumstances not be evacuated before or during discharge - Inert Gas Agent concentration within $\pm 5\%$ of design, with maximum concentration not exceeding 42.8%, corresponding to the No Observable Adverse Effect Level in accordance with NFPA2001. unless otherwise specified in the Department's Supplementary Specification

2.4.6 Discharge Time

The Inert Gas Agent distribution system shall be designed to achieve discharge of not less than 95% of the total quantity of extinguishing agent in 60 seconds (slowest allowable discharge), but not more than 95% of the agent in 40 seconds (quickest allowable discharge).

2.4.7 Discharge Pressure and Pipe Specification

The Contractor shall perform a complete design calculation of distribution system parameters on both balanced and unbalanced systems, single zone or multi-zone installations, such as (among others):

- < Manifold flow and maximum pressure.
- < Pressure drop across main orifice.
- < Actual branch flow rates.
- < Actual maximum branch pressure.
- < Actual nozzle flow and terminal pressure.
- < Actual flooding factor (concentration) for every protected zone.
- < Exact pipe and nozzle sizes, as well as nozzle orifice codes.
- < Actual discharge time.

The Contractor shall verify that the pipe specifications per clauses 4.4 and 4.6 of this document are applicable for the pressures anticipated during a discharge of Inert Gas Agent. The Contractor shall assume maximum agent pressure for pipe design purposes, i.e. storage at elevated temperature (55°C per NFPA 2001), which is in excess of normal agent pressure at 21°C.

Any Inert Gas Agent distribution system shall be designed such that pressure downstream of main orifice does not exceed 80Bar, unless specifically indicated otherwise in the Department's Supplementary Specification. Where deviation from this rule is indicated, then the Contractor shall include in his detail design respecification of piping material and standard by a competent individual, and in accordance with the guidelines and requirements of NFPA 2001.

Regardless of actual discharge pressures, any piping used in an Inert Gas Agent distribution system shall have a minimum rating in excess of 69Bar, as required in NFPA2001.

2.4.8 Venting of Space Overpressure

The envelope of all protected spaces shall be assumed airtight for design purposes. Where there are known penetrations in the envelope, these will be specifically mentioned in the Supplementary Specification.

The Contractor shall during his detail design evaluate the airtightness of every space envelope. He shall calculate the vented area required to limit overpressure at any stage during an Inert Gas Agent discharge to 50Pa. specify an overpressure opening size. and supply a suitable overpressure venting louvre to be built in by others.

2.4.9 Provision for Standby Inert Gas Agent

If specified in the Supplementary Specification, a supply of standby Inert Gas Agent shall be provided for. Unless otherwise specified, such standby supply shall be permanently piped to the distribution system in accordance with the requirements of the Inert Gas Agent equipment manufacturer, and check valves shall be employed to avoid back pressure actuation of the standby cylinders during normal discharge.

The capacity of the standby supply shall be sufficient for the greatest single risk or group of risks to be protected at any one time. or as otherwise specified in the Supplementary Specification.

2.4.10 Zoned Discharge

Refer to clauses 2.4.3, 4.6.4. 4.6.5. and 4.6.7 of this document.

Zoned discharge shall only be allowable if specifically required in the Supplementary Specification, and shall not be allowable in a distribution system feeding an occupied space unless specifically requested in the Supplementary Specification. Under such circumstances. zoned discharge shall only be allowed if there is no possibility of exceeding maximum design concentration (42,8%) for occupied spaces. This requires, as a minimum guideline, that:

- < The installation must incorporate metered discharge, i.e. actuation must be limited only to the number of cylinders required to attain design concentration in any particular space.
- < Where an installation incorporates unmetered discharge, i.e. where all cylinders in an installation are discharged at once, any occupied spaces must be either the largest zones. or that occupied spaces be of exactly equal volume after structural allowance, volume reductions, etc.
- < Where occupied spaces in an unmetered system are not the largest, the distribution system to such occupied spaces be fitted with waste nozzles to divert excess extinguishing gas outside the space.

Zoned discharge shall be arranged as shown in clauses 6.2 or 6.3 of this document.

2.5 REMEASUREMENT OF SPACES

The Contractor shall remeasure every space fitted with an Inert Gas Agent protection system prior to installation and commissioning of the system, and he shall not proceed with manufacture or installation until such time as he has confirmed in writing to the Department or Engineer that he has found the protected spaces to be in accordance with his approved design.

If at any stage during installation or commissioning periods, any protected space is changed, resulting in a space which does not conform to the approved design, be it with regard to room dimensions, vented area, volume reductions, etc. the Contractor shall inform the Engineer, and upon instruction, he shall without delay make the required alterations to the installation to comply with all aspects relating to the extinguishing gas requirements.

At first delivery, the Contractor shall confirm in writing to the Department or Engineer that every protected space has been remeasured. and found to be in accordance with the approved design. First delivery shall not be accepted without this written confirmation.

2.5.1 Uncloseable Openings

Where the envelope of any protected space includes uncloseable openings, e.g. open

gullies, chimneys, etc., such unclosable openings will be listed in the Supplementary Specification. Upon taking up his detail design, the Contractor shall perform an inspection of any existing buildings, and survey the latest available architectural drawings to verify that there are no additional unclosable openings.

The Contractor shall include adequate measures to ensure design concentration of Inert Gas Agent in such spaces. These measures shall be described in his detail design documentation submitted to the Department or Engineer.

Where screening nozzles are employed, the quantities of Inert Gas Agent required for such protection shall be in addition to the normal requirements for total flooding.

3. SECTION 3: GENERAL TECHNICAL REQUIREMENTS

3.1 ERECTION OF EQUIPMENT

Tenderers shall allow for a complete installation, including provision of mobile cranes, air compressors, lifting and rigging tackle, measuring equipment, precision levels, and all other special or regular tools and equipment that may be needed to complete the entire installation in accordance with the specification, and to the satisfaction of the Department.

The Contractor shall be held responsible for any damage caused to building, equipment, etc. during the course of the erection of this equipment.

All distribution piping and fittings shall be installed in accordance with good commercial practice and the piping layout shall be such as to reduce frictional losses to a reasonable minimum. Care shall be taken to avoid possible restriction due to foreign matter and faulty fabrication.

3.2 CLEARANCES

All pipe runs and system components shall be so located so as to maintain a minimum clearance of 200mm from electrical conduiting or equipment, unless greater clearance is indicated in the Supplementary Specification or on Departmental drawings.

3.3 EQUIPMENT FIXING

The Contractor shall be responsible for the supply of all necessary anchor bolts or studs for fixing down of any equipment supplied by him.

Where equipment is to be bolted down on concrete plinths, anchor studs shall preferably be cast into concrete bases. In such instances, the thread of the anchor studs shall be suitably protected to readily facilitate repeated disassembly of fixing assemblies.

Where equipment is to be fixed to concrete or brickwork surfaces, and where building or casting in is not feasible or desirable, fixing shall be by means of approved expansion type anchor bolts. Due care shall be taken to ensure adequate penetration of any expansion bolt, to eliminate surface damage.

All pipelines shall be firmly bracketed to walls and ceilings to the satisfaction of the Department. Any piping system shall be securely supported with due allowance for expansion and contraction and shall not be subject to possible damage.

3.4 ASSEMBLY OF EQUIPMENT

The Contractor shall supply all bolts, fasteners, fittings, braces, supports, packings, gaskets, etc. necessary for assembling all equipment supplied by him. All such items required for assembly shall be supplied by the manufacturer of the Inert Gas Agent equipment, or alternatively approved by the manufacturer.

Assembly of equipment shall be done in accordance with the requirements of the Inert Gas Agent equipment manufacturer. Assemblies shall be neat and in accordance with the Department's requirements regarding quality of workmanship.

All pipe ends shall be reamed clean of any burrs before assembly. Contractors shall physically check the inner diametral tolerance of particularly smaller pipe sizes for conformity with the prescribed specification.

Contractors are advised to blow through all distribution pipework and nozzles to ensure that no blockages exist, prior to performing the full discharge test.

3.5 WELDING

Only coded welders in possession of a valid, approved certificate of competency shall be employed. The Contractor shall submit copies of the certificates of every coded welder employed to do welding on an Inert Gas Agent installation. Any welding shall be carried out in accordance with the current edition of SABS 044 Parts I to VII as applicable.

All welding shall be free from porosity, cavities and entrapped slag, and shall show proper fusion. Any joints in a weld run shall be smooth with no pronounced hump or crater in the weld surface. No grinding of any nature on welding shall be accepted.

The profile of the weld shall be uniform, of approximately equal leg length and free from overlap at the toe of the weld. Unless otherwise specified the surface shall be either flat or slightly convex in the case of fillet welds and with reinforcement of not more than 3mm in the case of butt welds. The weld face shall be uniform in appearance throughout its length.

Filler metal electrodes shall be of an approved type for the material being used and shall be kept in a dry condition. All electrodes shall conform to SABS 455.

3.6

PAINTING

The entire installation, other than brass cylinder valves or diverting valves, braided hose and associated couplings, brass nozzles, etc. shall be painted, unless otherwise specified in the Supplementary Specification.

Before any painting is applied, the surfaces shall be prepared in accordance with SABS 064. Code for Preparation of Steel Surfaces for Painting. All surfaces shall be moisture free, degreased and otherwise clean, and properly prepared.

All black piping, flat iron, angle iron, rods, etc. for supports, brackets, frames, etc. shall be painted on all sides with a red oxide primer to SABS standard, followed by two finishing coats of enamel paint to SABS 630 Grade 1.

All Inert Gas Agent equipment, with exception of those not to be painted, or items such as storage cylinders with manufacturer's painted finish, shall be painted in SABS C34 - Light Stone, in accordance with SABS 0140-3. All Inert Gas Agent distribution piping shall be labelled as "INERT GAS AGENT" in SABS A11 - Signal Red where any pipework enters or leaves a space, at no less than 3 metre intervals.

Name plates, labels, and notices on equipment shall not be painted, and be suitably masked to avoid overruns. Painted surfaces on proprietary manufactured items shall be adequately protected. Equipment on which the paintwork has been damaged during installation shall be repainted before first delivery of the installation.

During painting, the Contractor shall ensure that all the necessary fire prevention and fire fighting precautions have been taken.

3.7

ELECTRICAL EQUIPMENT & INSTALLATION

Supply and chasing of conduiting shall be included in the Contractor's scope of works, unless specifically indicated as otherwise in the Supplementary Specification.

3.7.1

Cabling

Refer to F.P.O./82/5E - Standard Technical Specification for an Automatic Fire Alarm System - latest edition.

3.8

PIPE AND EQUIPMENT ANCHORING

Proper provisions shall be made in the fixing of all equipment to eliminate excessive transmission of vibration or noise to walls, etc. during discharge. All piping shall be supported at adequate intervals so as to eliminate generation of standing vibration or movement of any part of the installation during an Inert Gas Agent discharge.

4. SECTION 4: TECHNICAL REQUIREMENTS - EQUIPMENT & MATERIALS

4.1 GENERAL

4.1.1 Equipment Design and Manufacture

Refer to clause 1.3 of this document. All Inert Gas Agent equipment shall fully comply with these requirements.

All equipment shall be designed for the service they will encounter and shall not be readily rendered inoperative or susceptible to accidental operation. Equipment shall be normally designed to function properly from -10°C to 45°C or marked to indicate temperature limits. A tenderer offering equipment not suitable for this duty shall list such equipment as a tender deviation.

All equipment shall be located, installed and protected such that they will not be subject to mechanical, chemical, or other damage which would render them inoperative

4.2 INERT GAS AGENT STORAGE CYLINDERS

4.2.1 Cylinder Construction & Compliance

Any Clean Agent Inert Gas Agent storage cylinder shall be compliant with the requirements of the Occupational Health and Safety Act as amended, and shall further be designed and manufactured in accordance with a design code acceptable to the Department of Public Works. Every Inert Gas Agent storage cylinder shall be individually stamped with a unique serial number.

The Contractor shall provide written proof of compliance with such design code by the manufacturer.

All Inert Gas Agent storage cylinders shall be supplied new. and all cylinders forming part of an Inert Gas Agent installation shall be of identical size and design, and interchangeable without any modification whatsoever.

4.2.2 Submittal of Pressure Vessel Test Certificates

The Contractor shall submit test certificates for each and every storage cylinder before bringing them onto site. Where no certificates have been issued, the Contractor shall submit a list of cylinders, including manufacturer, serial number, and the date and test pressure of the latest hydrostatic test stamped on every cylinder.

4.2.3 Cylinder Shipping

Cylinder shipping shall be in accordance with the design code of the cylinders.

Storage cylinders shall be shipped fully charged, and with an approved protective cap over the Inert Gas Agent cylinder valve. Protective caps shall be removed only once cylinders have been finally bracketed into position.

Any Inert Gas Agent cylinder found, by the Engineer or any representative of the Department without a properly mounted valve cap. and which is not fixed into final position, shall be rejected by the Department, and replaced at his own expense by the Contractor.

4.2.4 Cylinder Charge

Charging of any Inert Gas Agent cylinder shall be done by a certified organisation, which carries the approval of the Inert Gas Agent equipment manufacturer or supplier.

The Contractor shall hand over a charging certificate for every charged cylinder before commissioning commences, which confirms that charge composition is within the allowable

tolerance. The charging certificate shall indicate the cylinder serial number, date of charge, location where charged, and charge contents.

4.2.5 Cylinder Installation & Bracketing

Storage cylinders shall be installed in banks:

- < not exceeding three rows in depth, where clear access is limited to one side of the bank.
- < not more than six rows deep, where clear access is available from both sides of the bank.

All cylinders shall be securely positioned by means of a rigid bracketing assembly, which eliminates any lateral movement of cylinders after installation.

Where cylinder banks are arranged against walls, provided that such walls shall be at least half brick masonry walls or heavier, the bracketing arrangement shall be securely anchored to the wall by means of expansion bolts of adequate size. penetration, and at intervals not exceeding 900mm.

Where cylinder banks are free standing, or walls are of construction which does not allow wall mounting, the bracketing arrangement shall be securely anchored to the floor by means of sectional steel channel with flanged support feet to take expansion bolts. Such expansion bolts shall be no less than M12x100. or as otherwise detailed in the Supplementary Specification.

4.2.6 Cylinder Enclosures

Inert Gas Agent storage cylinder banks, or single cylinders, shall be enclosed in lockable steel enclosures unless installed in dedicated, lockable rooms to which access can be limited to fire protection personnel.

Enclosures shall be brickwork enclosures as detailed in the Supplementary Specification, or constructed out of heavy sectional steel frame with expanded metal panels. Unless otherwise specified, enclosures shall be painted.

4.2.7 Pressure Testing Devices

Every Inert Gas Agent installation shall be supplied with pressure gauges on each and every cylinder. Pressure gauges shall indicate a green zone of pressures, which are acceptable, a red overpressure zone, and a yellow underpressure zone.

Every Inert Gas Agent installation shall be supplied with at least two removable pressure gauges indicating Bar pressure, and suitable for taking readings from the pressure port on every cylinder valve.

4.3 INERT GAS AGENT CYLINDER VALVES

4.3.1 Valve Construction

Inert Gas Agent cylinder valve bodies and components shall be manufactured from brass; either die cast or machined from solid stock.

Every valve shall include the following features:

- < Threaded neck matching storage cylinder.
- < Threaded discharge port.
- < Threaded back pressure actuation port if not incorporated into discharge port.
- < Threaded fill & test port with check valve.
- < Frangible safety disc.

The release mechanism employed shall hold the cylinder valve in the closed position and shall be designed to hold the valve opening devices firmly in the readiness position at all

times without the risk of metal fatigue or accidental operation through vibration or jarring, yet be sensitive to be instantly tripped by either manual or automatic operation as required, without undue force.

Inert Gas Agent cylinder valves shall be suitable for electric solenoid or mechanical actuation. An adequate and reliable source of energy shall be used. NO DETONATORS SHALL BE ACCEPTABLE.

Valves shall be guaranteed to be leak proof for 5 years after handover. The Contractor shall hand over a certificate of guarantee from either manufacturer or supplier at the time of first delivery.

4.3.2 Electric Solenoid Valve Actuation

All Inert Gas Agent installations shall be discharged via electric solenoid actuation by a detection system, unless otherwise specified in the Supplementary Specification.

Electric actuation of Inert Gas Agent cylinder valves shall be accomplished by means of one of the following methods:

- < Pre-discharge of Inert Gas Agent from the cylinder itself into the back-pressure actuation port of the cylinder valve.
- < Direct solenoid actuation of plunger acting on main valve seat.

Solenoid input shall be 24V DC.

4.3.3 Manual Valve Actuation

Manual discharge of Inert Gas Agent installations shall be included only if requested in the Supplementary Specification.

Manual actuation shall be accomplished by cammed lever actuation of a direct acting plunger configured to lift the main seal off its seat. The assembly shall be configured such that the lever is locked in the open position once the system has been actuated, and shall be fitted with a removable locking pin tethered to the body of the mechanism with steel rope or chain.

Manual control for actuating discharge of Inert Gas Agent shall be located so as to be conveniently and easily accessible at all times, including time of fire. Such control shall cause the complete system to operate as for the normal automatic mode.

Any manual actuation arrangement shall be in accordance with the Inert Gas Agent equipment manufacturer's requirements, and to the satisfaction of the Department.

4.4 INERT GAS AGENT MANIFOLDS

For the purpose of this specification, a manifold shall be considered to be the common distribution header upstream of the main discharge orifice, to which storage cylinder hoses and other ancillary items of equipment are connected.

4.4.1 Manifold Construction

Inert Gas Agent manifolds shall be of welded construction throughout. Where sections of manifold need to be joined, these joints shall be flanged and bolted.

Threaded connections to cylinder hoses or ancillary equipment such as air vents, etc, shall be in the form of sockets welded to the manifold. No other threaded connections shall be acceptable.

Manifolds shall be single continuous manifolds or sectional flanged manifolds.

Manifolds shall be either manufactured by the ISO9001 certified manufacturer of the Inert Gas Agent equipment, or fabricated by the Contractor.

Manifolds manufactured by Inert Gas Agent equipment manufacturers shall be certified suitable and tested by them. No manifold may be fabricated on site, or welded on site after pressure testing is complete.

Manifolds fabricated by Contractors shall be constructed of welded seamless carbon steel pipe to ASTM A106 Grade B (latest edition). Manifolds in 150Bar systems shall be fabricated from Schedule 80 piping. Any higher-pressure manifolds shall be fabricated from at least Schedule 160 piping. Such piping shall under no circumstances be bent or otherwise deformed, whether by hot or cold working. The Contractor shall hand over to the Department or Engineer certificates verifying the standard and grade of piping purchased.

All pipe fittings such as elbows, Tees, etc, shall be socket weld forged steel fittings to ANSI B16.11 Class 3000lb (latest edition). All threaded connections such as hose sockets shall conform to ANSI B1.20.1 (latest edition).

4.4.2 Welding

All welding on an Inert Gas Agent manifold shall conform to SABS 044, performed by coded welders, and preferably machine welded. Suitable approved electrodes shall be used.

The Department of Public Work retains the right to inspect, at any stage of manufacture, the welds on any manifold. This right of inspection, whether exercised or not, shall not in any way detract from the right of the Department to reject inferior equipment at any stage.

Where the Department, at its sole discretion, feels that welds may be of inferior quality, it may require of the Contractor that he performs or have performed X-ray testing of such welds, at the Contractor's expense.

4.4.3 Flexible Connection Hoses

Flexible connection hoses shall consist of flexible, steel reinforced hose, with swaged-on threaded connectors on either end, and shall incorporate a check valve to prevent agent loss in case of a discharge with any cylinder disconnected from the hose for any reason.

Flexible hoses shall be individually pressure tested before installation. Thereafter, flexible hoses shall be individually pressure tested at 5 year intervals, in accordance with NFPA2001. Contractors shall specifically include this requirement in the operating manuals.

4.4.4 Venting Requirements

In cases where a manifold or sections of manifold can be isolated from the open distribution system in such a manner as to allow pressure buildup inside such isolated sections, then every such isolated section shall be fitted with a vent plug.

Vent plugs shall be capable of venting gas resulting from leakage past cylinder valves, check valves, directional valves, or other, from the manifold to avoid buildup of pressure over prolonged periods. These vents shall close upon full discharge, eliminating loss of discharge gas through the vent.

4.4.5 Pressure Testing

All manifolds, sections of manifold, flexible connection hoses, and items of ancillary equipment open to manifold pressure shall be hydrostatically pressure tested to $1^{1/2}$ times normal working pressure.

All equipment supplied by ISO9001 certified manufacturers or distributors shall be pressure tested by such manufacturer or distributor, and certificates from the manufacturer shall be handed over to the Department or Engineer.

Any equipment not tested by an ISO9001 certified manufacturer or distributor, shall be inspected and pressure tested by a third party inspection authority, which carries the

approval of the Department of Labour, as part of the Contractor's scope of works.

Pressure test certificates shall be submitted before any equipment requiring pressure testing is brought onto site.

4.5 INERT GAS AGENT MAIN ORIFICE

Any Inert Gas Agent main orifice shall be either a clamped plate orifice or configured as a nipple, and connected on the upstream side to the manifold, and on the downstream side to the distribution pipe system. Contractors shall ensure that the orifice is installed for the right direction of flow.

All main orifices shall be supplied by the ISO9001 certified manufacturer of the Inert Gas Agent equipment. No Contractor or other party shall under any circumstance be allowed to perform any drilling, machining, or other work or modification on an orifice assembly.

Any main orifice shall be certified by its manufacturer as suitable for the application intended, and a certificate to this end handed over to the Department or Engineer.

The main orifice shall be positively anchored to the building structure, in accordance with requirements of the equipment manufacturer, and to the satisfaction of the Department, to avoid pipe movement during discharge. The Contractor shall specifically detail his main orifice fixing arrangement on his drawing submittals for approval by the Department

4.5.1 Main Orifice Union

An orifice union shall incorporate a stainless steel orifice plate clamped between bolted clamping flanges or inside a threaded union. The orifice opening shall be drilled by the manufacturer, and the opening size clearly and indelibly stamped on the orifice assembly.

4.5.2 Main Orifice Nipple

An orifice nipple shall be brass construction, with center hex for assembly purposes. The orifice opening shall be drilled by the manufacturer, and the opening size clearly and indelibly stamped on the body of the nipple.

4.6 INERT GAS AGENT DISTRIBUTION SYSTEMS

For the purpose of this specification, an Inert Gas Agent distribution system shall be considered to be the entire distribution pipe system downstream of the main orifice, inclusive of all other ancillary items of equipment connected to it.

4.6.1 Distribution Piping Downstream of Main Orifice

All distribution piping shall be Schedule 40 seamless carbon steel pipe to ASTM A106 Grade B (latest edition). Distribution piping shall under no circumstances be bent or otherwise deformed, whether by hot or cold working. The Contractor shall hand over to the Department or Engineer certificates verifying the standard and grade of piping purchased.

All pipe fittings such as elbows, tees, etc. shall be forged steel fittings to ANSI B16.11 Class 3000lb (latest edition). All pipe flanges shall be steel flanges to ANSI B16.5 Class 600lb (latest edition). All threaded connections shall confirm to ANSI B1.20.1 (latest edition).

All distribution pipe and fittings of 065mm (2½ inch) and smaller shall be threaded. Pipe fittings of 080mm (3 inch) and over shall be welded. No distribution pipe shall be sized larger than 0200mm (8 inch).

Distribution piping downstream of the main orifice shall be tested to $\sqrt{2}$ times full working pressure (120Bar) for 4 hours after assembly of the pipework, prior to installation of nozzles and venting fittings.

Distribution pipe shall continue in line with the main orifice for at least 10 pipe diameters

before any fittings or change in direction to allow flow stabilization.

4.6.2

Pipe Support and Fixing

Piping shall be hung by means of pipe hangers of appropriate dimensions as indicated in the Supplementary Specification, or as detailed on drawing. Floor support shall be heavy gauge mounting channel of minimum 2.0mm material thickness with appropriate pipe saddles of approved manufacture.

Maximum hanger spans shall be as follow:

Pipe Diameter	Maximum Span
<25mm	1.5m
<40mm	2.5m
< 65mm	3.0m
>65mm	3.5m

Hanger rod diameters shall be as follows:

Pipe Diameter	Hanger Rod Diameter
<40mm	< 8mm
40 - 80mm	< 10mm

Hanger rod lengths shall be kept as short as possible to facilitate rigid mounting. Where long hanger rods are unavoidable, then hanger rod diameter shall be increased to a suitable dimension, and additional lateral bracing of pipe runs shall be allowed for as part of the scope of works.

Floor or wall mounted pipes shall be mounted as follows

Pipe Diameter	Maximum Span
<25mm	1.5m
<40mm	2.5m
< 65mm	3.0m
>65mm	3.5m

All distribution piping shall be laterally braced to prevent lateral deflection under discharge conditions.

4.6.3

Cleaning of Piping

All piping shall be externally degreased and blown through before discharge nozzles are installed. The Contractor shall ensure that no metal filings or other matter able to block orifices or nozzles are left behind in piping after installation.

4.6.4

Directional Valves

Directional valves, as supplied by the certified manufacturer of the Inert Gas Agent equipment, shall be installed if requested in the Supplementary Specification.

The design of any directional valve shall allow removal of each valve from its pipeline without having to dismantle the line. The directional valves shall be of a straight through type and shall open fully within a 90° spindle movement.

Directional valves shall always be installed after a main orifice. Where system layout is such that directional valves are normally closed, the directional valves used shall be rated and tested to full system storage pressure. Where low pressure rated directional valves are used, these shall be rated for working pressure of no less than 80Bar, and tested to no less than 120Bar, unless otherwise specified in the Supplementary Specification.

Where high pressure rated directional valves are used, the manual or automatic operation of the Inert Gas Agent installation shall drive open the particular directional valve serving the hazard to be flooded, immediately prior to the release of gas. Where low pressure rated directional valves are used, these shall always be configured normally open, with valves to zones not requiring flooding driven closed immediately prior to discharge.

4.6.5 Check Valves

Check valves shall be as per the specification of the certified manufacturer of the Inert Gas Agent equipment.

4.6.6 Discharge Nozzles

Discharge nozzles shall be as supplied by the certified manufacturer of the Inert Gas Agent equipment, and shall be of adequate strength for use with the expected working pressures, able to resist normal mechanical damage, and constructed to withstand expected temperatures without deformation.

Discharge nozzles shall be brass with male threaded connections to ANSI B 1.20.1. and compatible with the pipe thread being used. The Contractor shall individually ensure that the thread on each and every nozzle matches pipe thread before commissioning.

Sufficient discharge nozzles shall incorporate frangible disc safety devices to limit pressure to 100Bar (1450psi), or other pressure indicated by the Inert Gas Agent equipment manufacturer, or alternatively separate rupture disk fittings shall be employed. These safety discs shall be designed to fracture in controlled manner without separating completely from the body of the nozzle or fitting to avoid possible injury.

All discharge nozzle orifices shall be pre-drilled by the certified manufacturer of the Inert Gas Agent equipment, and the equivalent single orifice size clearly and indelibly stamped on the nozzle body, regardless of shape and number of orifices. This equivalent size shall refer to the size of standard single orifice type with rounded entry and a coefficient of discharge of not less than 0.98, having the same flow rate as the nozzle in question. No Contractor or any other party shall under any circumstance be allowed to modify in any way any pre-drilled nozzle orifice.

Where possible, a minimum of two nozzles shall be provided in every protected space, or any part or subdivision separated from the main part of the protected space by any physical barrier, such as access flooring or ceiling. Single nozzles shall only be used in spaces too small to accommodate two nozzles. Where single nozzles are installed, blind elbows shall be fitted.

All discharge nozzles shall be located to achieve the best results and shall be selected and so positioned that the discharge will not splash flammable liquids or create dust clouds that might spread a fire, create an explosion, or otherwise adversely affect the contents of the protected space. Nozzles vary in design and discharge characteristics and shall be selected on the basis of their suitability for the use intended.

Where any Inert Gas Agent nozzle is installed in dirty or dusty environment, it shall be fitted with a plastic protective cap, which shall be blown off on discharge of extinguishing gas without causing injury to anyone in its direct vicinity.

4.6.7 Venting of Pipework

All closed distribution pipework, ie. where directional valves, check valves, etc. have been employed, shall be ventilated by means of brass ventilation orifices of 00.4mm. or as

otherwise specified by the certified manufacturer of the Inert Gas Agent equipment. Such ventilation orifices shall nevertheless not be of any size that will cause noticeable leakage of extinguishing agent during discharge.

4.7

INERT GAS AGENT FIRE DETECTION & ACTUATION SYSTEMS

Refer to clause 2.4.3 of this document.

Every Inert Gas Agent installation shall incorporate an automatic fire detection system in accordance with F.P.O./82/5E - Standard Technical Specification for an Automatic Fire Alarm System.

Such fire detection system shall be an automatic fire detection system by an approved manufacturer, or as otherwise specified in the Supplementary Specification.

Inert Gas Agent fire detection systems may be either conventional or analog addressable, however:

- < The function of any fire panel shall be limited to the conveyance of first and second knocks only to one or more gas control units.
- < Monitoring of door status, alarm outputs etc. shall be gas control unit functions.
- < The intelligence to actuate gas discharge based on 1st & 2nd knock status, door lock status, auto/manual/reset, etc. shall reside in the gas control unit.
- < Every protected space shall be equipped with a single, unique gas control unit, which shall be mounted next to the main entrance door to the space. In cases where more doors allow access to a protected space, these entrances shall be fitted with either remote or status panels, as required in the Supplementary Specification.

4.7.1

Fire Detection Panel

Every Inert Gas Agent fire detection system shall incorporate at least one fire panel. All fire detectors and field devices, with the exception of monitored doorlocks, doorclosers, alarm devices associated with protected spaces, and gas actuation hardware shall be wired back to the fire panel/s.

Any conventional fire detection control panel shall support the following features:

- < Every protected space shall be covered by at least two unique, independent detector circuits - these circuits shall not be used in any other protected space.
- < Fire divisions in a protected space may be served by the same detector circuits.
- < Every detector circuit shall contain at least two detectors per fire division.
- < The panel shall be programmable to generate first knock on activation of any one detection device on any circuit, and second knock on activation of a detection device on another detector circuit in that protected space.
- < Communication of 1st and 2nd knocks in any protected space shall be via distinct, separate digital outputs hardwired to the gas control unit for that particular space.
- < The panel shall have at least two alarm output loops, and shall have adequate input/output capacity to allow all devices, interlocks and outputs required by the Supplementary Specification.

Any addressable fire detection control panel shall support the following features:

- < Every fire division shall be covered by at least two independent addressable fire detectors, which may be on the same single circuit.
- < All addressable detectors shall be logically linked to allow gas discharge zoning.
- < The panel shall be programmable to generate first knock on activation of any single detection device in a protected space, and second knock on activation of any other detection device in the same protected space.
- < Communication of 1st and 2nd knocks in any protected space shall be via distinct output calls addressed to the gas control unit for that particular space.

- < The panel shall have at least two alarm output loops, and shall have adequate input/output capacity to allow all devices, interlocks and outputs required by the Supplementary Specification.

A detection device shall be interpreted to be:

- < Any single smoke or heat detector
- < Any manual call point other than the integrated dual action call point on a gas control unit or remote panel - see clauses 4.7.2 & 4.7.3.
- < Any other device specified in the Supplementary Specification.

4.7.2 Gas Control Unit

Unless otherwise specified in the Supplementary Specification, any gas control unit installed as part of an Inert Gas Agent installation shall incorporate the following:

- < Dual LED's indicating automatic control of the detection system.-
- < Dual LED's indicating manual control of the detection system.
- < Dual LED's indicating gas isolation.
- < Dual LED's indicating gas discharge activated (count-down timer).
- < Dual LED's indicating fault condition.
- < Key switch to select manual or automatic control of the gas control unit. The key shall be captive in the automatic position, and permanently tethered by means of a cord or chain.
- < Key switch to select gas isolation. The key shall be captive in the gas isolation mode position, and permanently tethered by means of a cord or chain.
- < Buzzer indicating violation of access door lock status or state of closure.
- < Lamp test facility.
- < Hardwired input for gas pressure switch for fault indication.
- < Hardwired input for monitoring doorlocks.
- < Manual dual action callpoint for manual discharge.
- < Alarm outputs to alarm bells, sirens, strobes, and illuminated evacuation signage.
- < Gas discharge activation timer capable of at least 60-second delay.

In automatic mode, the gas control unit shall automatically initiate gas discharge on the second knock, activate alarms, etc. In manual mode, the gas control unit will sound all alarms, but fail to discharge gas. In manual mode, gas discharge shall only be possible via the dual-action manual call point. Any switching between manual and automatic modes shall not reset knock and alarm status of the gas control unit.

Selection of gas isolation mode shall result in isolation of the physical hardwired outputs to gas actuation solenoid, as well as resetting of all gas control unit knock and alarm statuses.

The power supply and battery serving every gas control unit shall specifically be rated for the maximum inrush current of the electric gas discharge actuator solenoid.

4.7.3 Gas Remote Panel

Gas remote panels shall be mounted adjacent to secondary entrances to a protected space, as specified in the Supplementary Specification. Unless otherwise specified in the Supplementary Specification, any gas remote panel installed as part of an Inert Gas Agent installation shall incorporate the following:

- < Dual LED's indicating automatic control of the detection system.
- < Dual LED's indicating manual control of the detection system.
- < Dual LED's indicating gas isolation.
- < Dual LED's indicating gas discharge activated (count-down timer).
- < Dual LED's indicating fault condition.
- < Buzzer indicating violation of access door lock status or state of closure.
- < Lamp test facility.
- < Hardwired status feedback from gas control unit.

- < Manual dual action callpoint for manual discharge.

Gas remote panel shall be wired back to gas control unit to mimic exactly all knock and alarm and operational statuses, and the manual callpoint shall allow manual gas discharge activation when in manual mode.

4.7.4 Gas Status Panel

Gas status panels shall be mounted adjacent to secondary entrances to a protected space, or any other location as indicated in the Supplementary Specification. Unless otherwise specified in the Supplementary Specification, any gas status panel installed as part of an Inert Gas Agent installation shall incorporate the following:

- < Dual LED's indicating automatic control of the detection system.
- < Dual LED's indicating manual control of the detection system.
- < Dual LED's indicating gas isolation.
- < Dual LED's indicating gas discharge activated (count-down timer).
- < Dual LED's indicating fault condition.
- < Buzzer indicating violation of access door lock status or state of closure.
- < Lamp test facility.
- < Hardwired status feedback from gas control unit.

Gas remote panel shall be wired back to gas control unit to mimic exactly all knock, alarm and operational statuses. No manual gas discharge activation shall be possible from a status panel.

4.7.5 Fire Detection Logic

The fire detection system shall be programmed to a double knock arrangement as follows:

First Knock:

Upon activation of any single detection device, as described in 4.7.1 above, the fire detection system shall:

- < Activate alarm bells.
- < Activate flashing Warning/Evacuation signage.
- < Flash fire condition on relevant detector loop indicator on fire panel - this will change to steady light upon alarm acceptance.

Cancellation of evacuation tones shall be carried out via the gas control unit reset. On recurrence of activation the evacuation shall proceed again as before.

Second Knock:

Upon activation of any second detection device, the fire panel shall:

- < Silence alarm bells
- < Activate sirens inside and outside protected space.
- < Activate strobes inside and outside protected space.
- < Re-activate fire panel whistle alarm.
- < Flash system activated on status panels.
- < Light Warning/Evacuate signage (steady)
- < Activate door closers.
- < Fire signals to A/C & building electrical supplies.
- < Initialise discharge timer on 60 seconds, or other interval specified in Supplementary Specification.

4.7.6 Audible and Visual Alarms

Bell alarms shall be 150mm in diameter and, unless specified otherwise in the Supplementary Specification, one bell alarm shall be installed in each protected space.

Sirens shall be installed inside and outside each protected space. Sirens shall, unless otherwise specified in the Supplementary Specification, be rated for 100dBA at 1m and shall incorporate an output stepping down facility. Siren starting frequency shall be 100Hz and the higher stabilised frequency 300Hz. or as otherwise specified in the Supplementary Specification.

Buzzers on gas control, remote and status panels shall be suitable to maintain a sound level of 70dBA at 3m.

4.7.7 Fire Interlocks

Any Inert Gas Agent installation shall be fire interlocked with both air conditioning, and electrical distribution systems of all protected spaces. Fire interlock signals shall be in the form of 24 Volt switched and fused output, configured to supply 24V under normal circumstances, and 0V in a fire situation. If the fire output from the fire panel is integrated into the panel in such a manner that any damage can result to the fire panel in case of short circuit or external overvoltage, then the fire output shall be fed through an external fused interposing relay.

4.8 DOORS AND DOOR EQUIPMENT

Unless otherwise specified in the Supplementary Specification doors shall be provided by others, but door locks and door closers, as specified in the Supplementary Specification, shall form part of the scope of works.

4.8.1 Door Locks

Door locks shall comply with the requirements, of the most recent issue of the Department's Standard Specification for Security Equipment. F.P.0.9E.

Any access door to an Inert Gas Agent protected space or zone shall be provided with a two-way monitored lock type PWD Sample 24MS as S300.3.1.b of F.P.0.9E. and an approved door closer that will automatically close the door prior to discharge.

Any escape door shall be fitted with an alarm escape lock type PWD Sample 127 as S300.3.1.C of F.P.0.9E.

Should access to a protected space be through another space which is already protected, then the aforementioned door shall be fitted with a lock set of type PWD Sample 24MS as S300.3.1.b of F.P.0.9E.

4.8.2 Door Closers

Door closers shall be supplied if required in the Supplementary Specification. Door closers shall comply with the requirements of the Department's Standard Specification for Security Equipment. F.P.0.9E (latest edition).

Any access door to an Inert Gas Agent protected space or zone shall be fitted with an approved door closer that will automatically close the door upon discharge. Door closers shall not be required on strongroom doors within a protected space.

Mechanically operated door selectors shall be fitted to all double doors.

Should access to a protected space be through another space which is already protected, then the aforementioned door shall be fitted with a door closer activated by either of the detection systems in the two zones.

4.8.3 Door Monitoring

Where three or more doors with locks that can be monitored, as PWD Samples 23, 24, and 127 are used, a monitoring panel shall be provided in accordance with clause S330 of the Department's Standard Specification for Security Equipment. F.P.0.9E.

Approved magnetic switch type door monitors shall be installed to monitor status of escape and access doors.

4.9

BREATHING APPARATUS

Every entrance to an Inert Gas Agent protected space shall be supplied with two independent sets of approved breathing apparatus comprising face mask and compressed air supply system (cylinder and pressure regulator). Any such breathing apparatus shall be suitable for at least 10 minutes continuous use.

Breathing apparatus shall be located inside a single lockable break glass metal box per entrance, or as otherwise indicated in the Supplementary Specification. Supply and installation of breathing apparatus and mounting box shall be included in the Contractor's scope of works.

4.10

CLOSING OF FIXED OPENINGS

4.10.1

Automatic Shutters

Automatic closing shutters shall be provided, as part of the Contractor's scope of works, at all fixed ventilation openings not connected to air conditioning or ventilation ducting. These shall close automatically by means of fire interlock or other approved method.

4.10.2

Asbestos Blankets

Approved asbestos blankets shall be provided, as part of the Contractor's scope of works, on the inside of all louvered doors or other openings that cannot be protected by automatic closing shutters or dampers. Such asbestos blankets shall adequately seal the ventilation openings.

The asbestos blankets shall normally be rolled up above the door opening, but shall drop down immediately by means of fire interlock or other approved method.

4.10.3

Dampers

Unless otherwise specified in the Supplementary Specification, dampers to all ventilation or air conditioning ducting entering or leaving a protected space shall be supplied and installed by others.

If the Supplementary Specification does require supply of these dampers, then they shall be spring loaded SABS approved 4 hour fire rated dampers with external reset linkages, and with 24V solenoid actuation. Such dampers shall close on a fire signal from the fire detection system.

Damper operation shall be powered from a properly sized independent power source, and shall not be able to interfere with operation of fire panel or gas control units. All necessary power supplies, batteries, relays, etc, shall be provided as part of this scope of works, regardless of the origin of dampers.

Where an air-conditioning unit serves only the protected space, such A/C system shall be switched off upon discharge or upon a fire signal from the fire detection system.

4.11

OPERATION INSTRUCTIONS AND SIGNAGE

Full operating instructions and block plan shall be provided for every Inert Gas Agent installation in the form of directions for use in English, framed and mounted under perspex in close proximity to the fire and status panels. All signage shall be included in the scope of works.

Signage shall specifically (but not exclusively) include:

< Flashing illuminated Warning/Evacuation signs on the inside and outside of every

entrance to any protected space.

- < "Inert Gas Agent Protection" warning signs inside protected space.
- < "Inert Gas Agent Protection" entrance warning signs.
- < "Inert Gas Agent Protection" warnings in all adjacent spaces, as well as plant room.
- < Notice warning occupants of expected results of discharge, namely noise, possible breathing difficulty, and possible danger for individuals with pacemakers.
- < All safety signage associated with Inert Gas Agent installations that may be required by any applicable legislation or NFPA.

5. SECTION 5: COMMISSIONING & MAINTENANCE

5.1 PRE-COMMISSIONING REQUIREMENTS

The following pre-commissioning requirements shall be met before the Contractor proceeds with commissioning.

5.1.1 Pressure Testing

All pressure test certificates, by the Inert Gas Agent equipment manufacturer or third party inspector shall be handed over to the Department.

5.1.2 Submittal of Approval Certificates

All approval certificates shall be handed over to the Department, including:

- < Designer certificate of competency.
- < Approval by ISO9001 certified manufacturer of detail design.
- < Storage cylinder test certificates.
- < Distribution manifold test certificate.
- < Materials certificates.

5.2 COMMISSIONING AND FIRST DELIVERY

The proper operation of the installation shall be demonstrated to the Engineer and a representative of the Department.

Where tests are conducted over areas in excess of the limits of normal speech, the Contractor shall make available at least 4 two way radios for proper communication.

The Contractor shall bear the cost of all consumables, materials or extinguishant required for demonstration purposes.

5.2.1 Fire Detection and Actuation System

Operation of the fire detection system shall be demonstrated as follows:

- < Operation of the detection system with respect to the gas installation to be checked with extinguishing system isolated.
- < All detectors to be triggered with ionisation aerosol or similar, and heat sources if applicable.
- < Checking of all alarms and interlocks
- < Checking of outputs to discharge actuation system.
- < One zone shall be tested with a fire and accelerant.

Where any of the above items are not to the satisfaction of the Department or Engineer, such shortcomings shall be rectified before further commissioning is witnessed.

5.2.2 Full Discharge Test

The Department of Public Works requires that a full discharge test be performed on every Inert Gas Agent installation as part of the commissioning and handover procedure. The Contractor shall bear all costs associated with this test, whether for labour, equipment hiring, consumables, Inert Gas Agent extinguishing media, or other, as part of his scope of works.

Where directional valves are employed in an installation, every separate discharge zone shall be tested individually.

The Contractor shall arrange for concentration measurement and logging, during the discharge test, of O₂ and CO₂ levels in every protected space. Logging shall start when system discharge is triggered, and shall continue for a period not less than 30 minutes, with

measurement samples every 10 seconds during the first 5 minutes, and every minute thereafter.

5.2.3 Witnessing of Commissioning Tests & Simulations

All commissioning tests, including full discharge tests, shall be witnessed by a representative of the Department or Engineer. Where tests have for whatever reason not been witnessed, it shall be assumed for handover purposes that they have not been performed, and first delivery shall under such circumstances not be accepted by the Department.

5.3 OPERATING & MAINTENANCE MANUALS. AS-BUILT DOCUMENTATION

Refer to F.P.O./82/5E - Standard Technical Specification for an Automatic Fire Alarm System -clauses 6.3 and 6.4.

Unless otherwise specified in the Supplementary Specification, the Contractor shall hand over to the Engineer, as part of his scope of works. 2 weeks prior to first delivery being accepted by the Engineer, one full set of his as-built documentation, including:

- One set of transparencies of his up to date working drawings.
- All electrical and control schematics.
- Complete detail design calculations.

Two draft sets of operational and maintenance manuals, prepared in English, and written in layman's terms, shall be handed over for comments to the Departmental Representative and Engineer respectively at least 2 weeks before first delivery.

Paper copies of all as-built documentation shall be bound into every operating and maintenance manual unless otherwise specified in the Supplementary Specification. Manuals shall be properly bound in a durable hard cover. Material shall be clearly legible, well organised, and be provided with index. Drawings and diagrams A2 and larger shall be folded to A4 size, and included in thick clear plastic pockets.

The Contractor shall hand over four (4x) sets of approved O&M manuals. First delivery shall not be accepted before the complete sets of approved O&M manuals have been handed over.

5.3.1 Operating & Maintenance Manual Content

Operating and maintenance manuals shall include the following sections:

SECTION 1: GENERAL

- Clear description of the system, including system diagram and controls.
- Schematic diagrams of all systems with space volumes, structural and volume reductions, design flooding factors, detection & actuation thresholds, etc.
- Schedules of equipment, complete with model numbers, optional extras, modifications, electrical requirements if any, etc.

SECTION 2: OPERATING PROCEDURES

Operating procedures for all items of equipment, specifically including:

- Gas isolation procedure.
- Alarm acknowledge.
- Alarm reset.
- Gas actuation.
- Fault finding checklists.

SECTION 3: MAINTENANCE SCHEDULES

- Daily maintenance check sheets.

- Monthly maintenance check sheets.
- Annual maintenance check sheets.
- Maintenance schedules for each item of equipment.

SECTION 4: MAINTENANCE INSTRUCTIONS

- Detailed maintenance instructions for each item of equipment.

SECTION 5: PARTS LISTS AND SUPPLIERS. AS-BUILT DOCUMENTATION

- Detailed parts lists of all consumable items of equipment with full ordering details.
- Detailed parts lists of all wearing or items generally requiring replacement ie. relays and other switchgear.
- List of suppliers of all the above items with addresses, telephone, and fax numbers.
- Paper copies of as-built documentation.

5.3.2 General Requirements

Sections 1, 2 and 3 to be specifically prepared for the contract. No standard forms or manufacturers literature is acceptable.

Maintenance check sheets to refer to items of equipment by name (i.e. Inert Gas Agent storage cylinders) and not general descriptions.

Maintenance instructions may consist of manufacturers printed instructions where these are detailed and pertinent. Copies of general technical and sales literature are not acceptable.

5.4 MAINTENANCE & GUARANTEE

5.4.1 Contractual Maintenance & Guarantee Period

Unless otherwise specified in the Supplementary Specification, every Inert Gas Agent installation shall be covered, as part of the Contractor's scope of works, by a free maintenance and guarantee period.

The length of the free maintenance and guarantee period shall be at least 12 calendar months from date of acceptance of first delivery by the Department of Public Works.

5.4.2 Maintenance Requirements

During the free maintenance and guarantee period, the Contractor shall perform:

- Monthly/quarterly inspections and maintenance as applicable.
- Comprehensive maintenance service at the end of a period of 11 months verifying all commissioning setpoints, proper operation etc.

Maintenance shall consist of maintenance in accordance with the maintenance schedules, and actual maintenance performed shall be recorded on the maintenance check sheets and signed off by a representative of the Department.

All inspections and services shall be followed, within 7 days of such inspection or service, by reports outlining:

- The scope of the inspection.
- Any maintenance carried out.
- General state of installation & items requiring further attention.

Reports shall be completed in duplicate and forwarded to the Regional Manager and the Director General, Department of Public Works, Private Bag X65, Pretoria, 0001.

All items requiring replacement, repair or service within the 12 months maintenance and guarantee period, whether equipment or consumables, shall be repaired, replaced or

serviced by the Contractor at ins own expense as part of this contract.

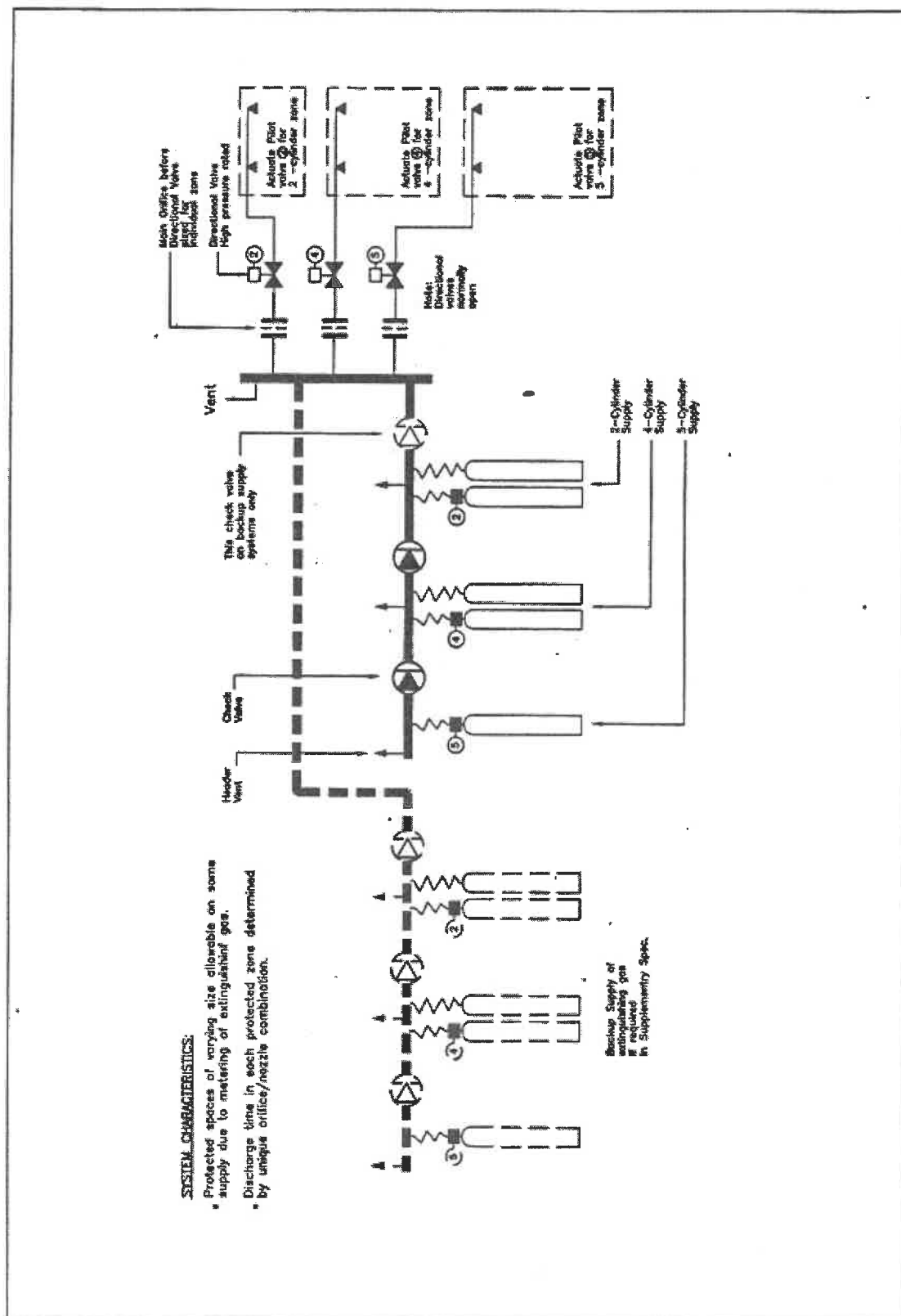
The system shall be fully guaranteed against all defects, and where a major defect occurs during the guarantee period, the item involved shall be guaranteed for a further 12 months from the date on which the defect was repaired, and the Department notified in writing.

6. SECTION 6: DRAWINGS, FIGURES & SCHEDULES

6.1.1 SCHEDULE 1 - DOCUMENTATION SCHEDULE

#	Documentation to be handed over	Special clause	Stage at which documentation is required	Notes:
			Design Submittals Prior to Installation First delivery & As built Docs	
6.1.1	System Approval	1.3.1	<	Required if system approval exists
6.1.2	Proof of ISO9001 certification	1.3.2	<	Required if no system approval exists
6.1.3	Person responsible for system design	1.3.1 & 1.3.2	<	
6.1.4	Component details & approvals	1.3.2	<	Required if no system approval exists
6.1.5	Builders work drawings	1.8.1	<	
6.1.6	System detail design calculations	1.8.2	<	
6.1.7	Working drawings	1.8.3	<	
6.1.8	Electrical and Controls Schematics	1.8.4	<	
6.1.9	Equipment samples	1.8.5	<	
6.1.10	As-built drawings & schematics	1.8.6	<	If required in the Supplementary Specification
6.1.11	Concentration performance tolerance certificate	1.12 & 2.4.5	<	
6.1.12	Confirmation of remeasurement	2.5	<	Prior to manufacture proceeding
6.1.13	Confirmation of remeasurement	2.5	<	Prerequisite for acceptance of first delivery
6.1.14	Coded welder certificates	3.5	<	Prior to manufacture proceeding
6.1.15	Confirmation of storage cylinder design code	4.2.1	<	
6.1.16	Storage cylinder pressure testing certificates	4.2.2	<	Prior to bringing onto site
6.1.17	Storage cylinder charging certificates	4.2.4	<	Prior to bringing onto site
6.1.18	Cylinder valve leak guarantee certificates	4.3.1	<	Prerequisite for acceptance of first delivery
6.1.19	Piping material certificates	4.4.1 & 4.6.1	<	
6.1.20	Results of X-ray testing on welds	4.4.2	<	If required by the Department
6.1.21	Pressure testing certificates	4.4.5 & 4.6.1	<	Pre-commissioning requirement
6.1.22	Full discharge test results- time/concentration logs	5.2.2	<	Prerequisite for acceptance of first delivery
6.1.23	Draft O&M manuals	5.3	<	3 weeks prior to first delivery
6.1.24	Approved O&M manuals	5.3	<	Prerequisite for acceptance of first delivery
6.1.25	Monthly/quarterly maintenance reports	5.4.2	<	During 12 months guarantee period
6.1.26	Comprehensive maintenance service report	5.4.2	<	Before expiry of 12 months guarantee period

FIGURE 1 - TYPICAL ARRANGEMENT FOR METERED ZONED DISCHARGE



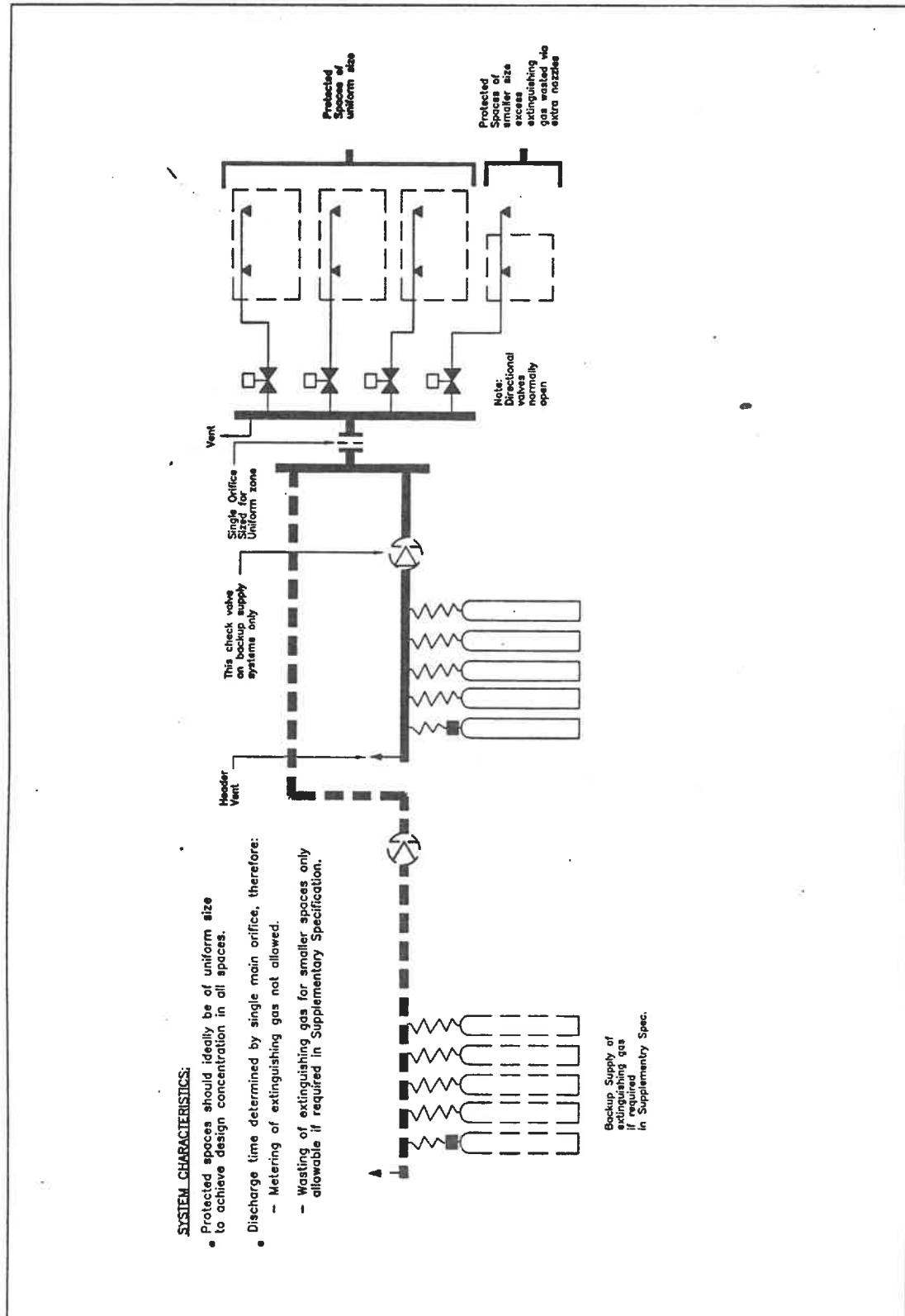
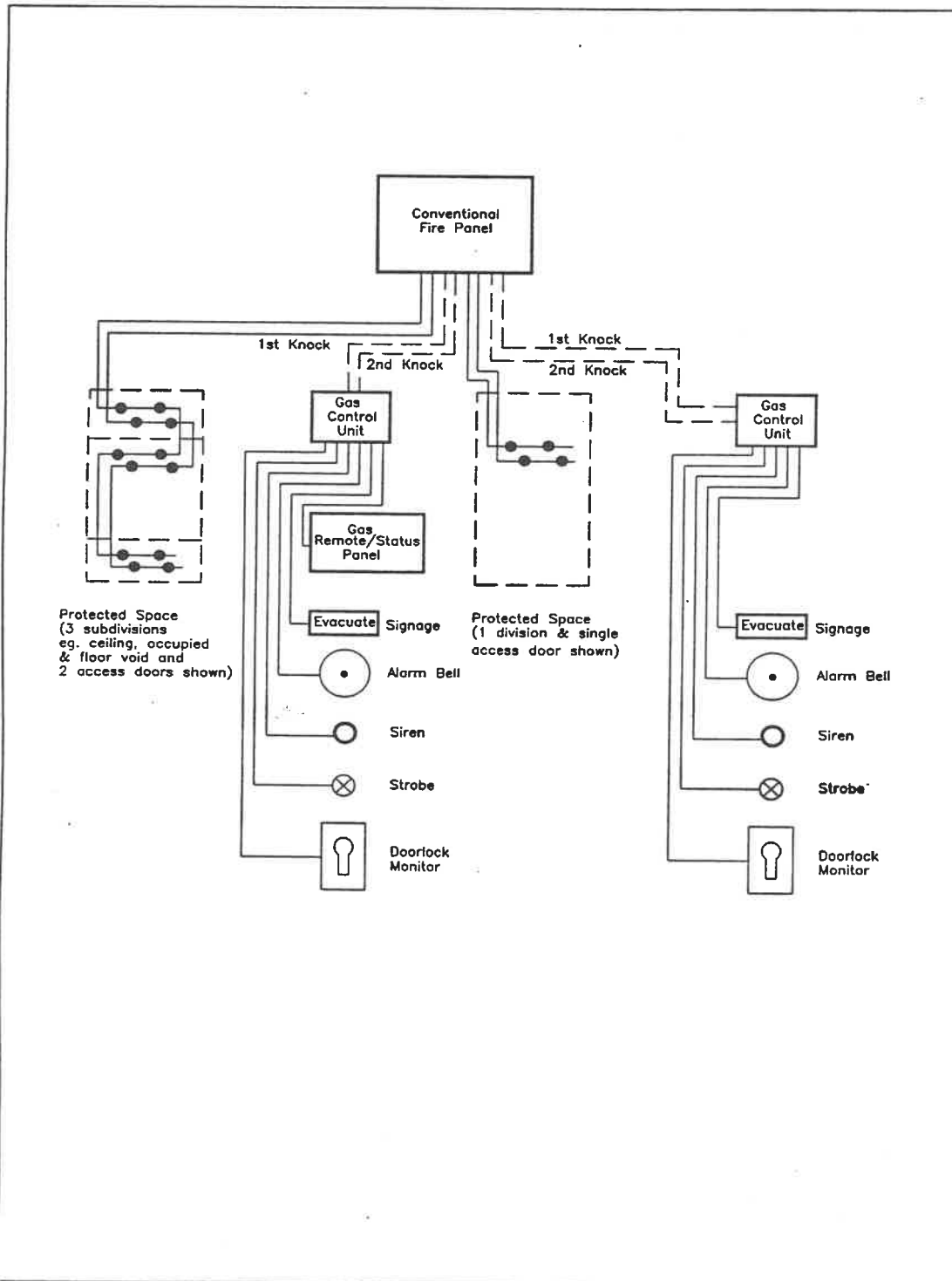
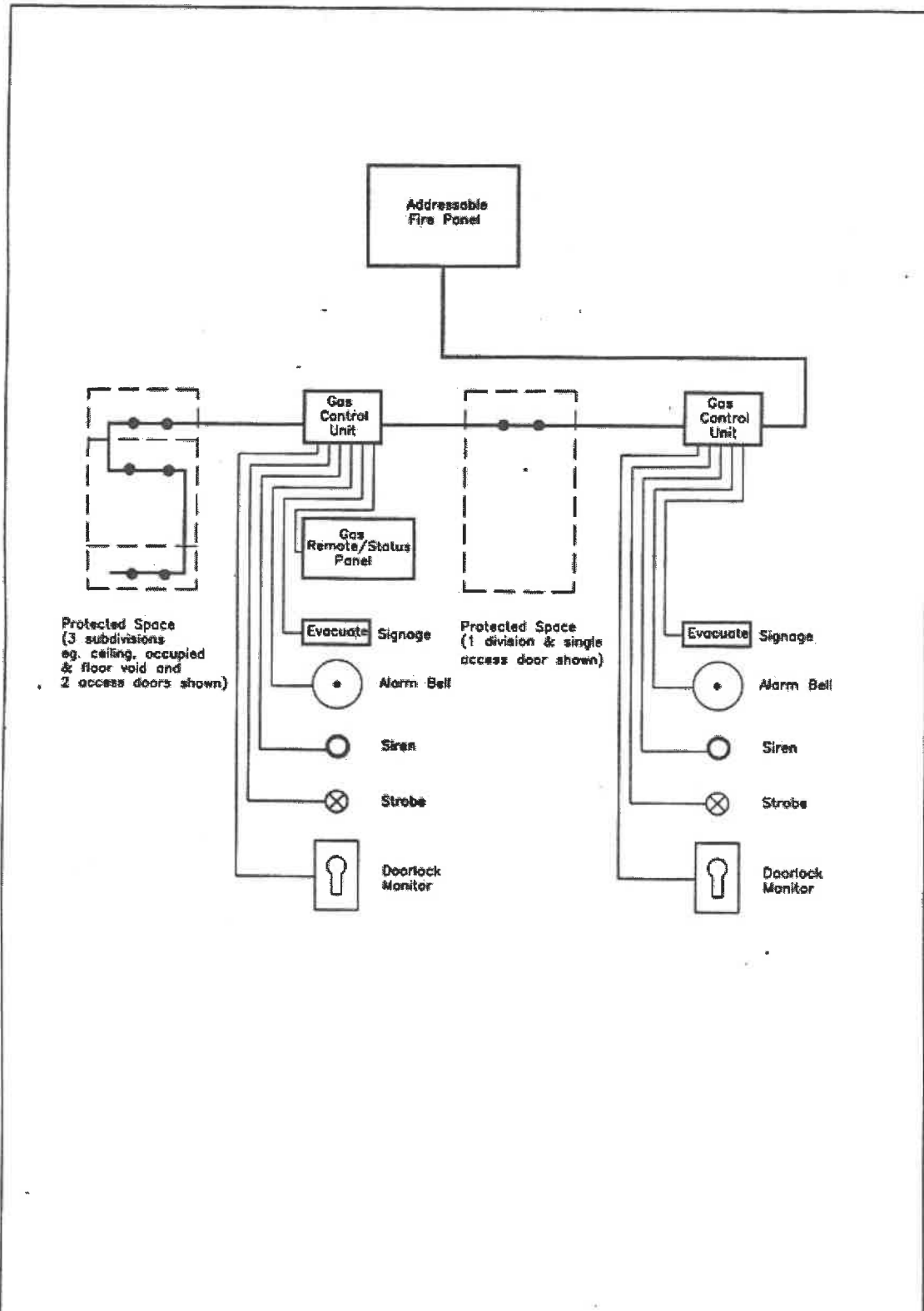


FIGURE 3 – TYPICAL CONVENTIONAL DETECTION ARRANGEMENT







DEPARTMENT OF PUBLIC WORKS

FIRE SECURITY

STANDARD TECHNICAL SPECIFICATION

FOR AN

AUTOMATIC SPRINKLER FIRE EXTINGUISHING SYSTEM

REVISED: OCTOBER 1981

REF. F.P.O./82/7E

STANDARD TECHNICAL SPECIFICATION
FOR AN
AUTOMATIC SPRINKLER FIRE EXTINGUISHING SYSTEM

CONTENTS

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3	Diameters of Sprinkler Pipes	1
4	Drawings and Approval	1
5	Water Supply	1
6	Sprinkler Control Valves	2
7	Pressure Gauges	2
8	Hydraulic Alarms	2
9	Materials	2
10	Pipe Joints	3
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12	Prevention of Air Locks	3
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Annexures: Annexure A : Schedules of Equipment and Materials.

STANDARD TECHNICAL SPECIFICATION

FOR AN

AUTOMATIC SPRINKLER FIRE EXTINGUISHING SYSTEM

1. GENERAL

This standard specification deals only with the general technical requirements for an automatic sprinkler fire extinguishing system. Tenderers are therefore referred to the Supplementary Specification for the particular scheme for the specific requirements applicable to the scheme.

2. DESIGN OF SPRINKLER SYSTEM

The rules and regulations (latest edition) as laid down by the Automatic Sprinkler Inspection Bureau ("A S I B"), hereafter referred to as the "Rules", shall apply.

3. DIAMETERS OF SPRINKLER PIPES

The sizes of all distribution pipes shall be designed hydraulically in accordance with clause 2 above.

In the case of extra high hazard protection the sizes of the branch pipes shall be determined in accordance with the applicable tables in the "Rules" unless specified otherwise in the Supplementary Specification.

The Contractor may submit a design based on full hydraulic calculations, but the Department is not bound to accept such an alternative.

Tenderers are to note that they are to tender strictly in accordance with the Department's requirements.

Tenderers shall attach their calculations to their tender.

4. DRAWINGS AND APPROVAL

A suitable layout for the required sprinkler installation is indicated on the Department's drawings referred to in the Supplementary Specification. The tender drawings shall be returned with the tender and any deviations from the Department's layout proposed by the tenderer shall be indicated thereon in RED.

Tenderers are to note that they are required to tender strictly in accordance with the layout of the Department.

In cases where air conditioning ducts, lights, etc., are being installed in the space to be protected, the successful tenderer shall consult the Regional Representative for any information in this connection before completing his detailed working drawings so as to ensure that the sprinkler system does not clash with any of the other services being installed.

Approval by the Department of the proposed detailed working drawings shall not reduce the contractor's responsibility in respect of the accuracy of his dimensions and the clashing of the system with other services or elements.

5. WATER SUPPLY

A single water supply connection terminating in a plugged socket in the sprinkler valve cupboard, in accordance with the drawings, will be supplied by others. The sprinkler contract is to commence at this point.

6. SPRINKLER CONTROL VALVES

A complete set of approved sprinkler control valves shall be supplied and connected to the plugged connection referred to in Clause 5. The control valves shall be of the "WET" type.

The sprinkler control valves shall be of a type approved by the Automatic Sprinkler Inspection Bureau (A S I B) particularly in regard to their general assembly, namely the size and arrangement of ancillary equipment; drain valves, test and alarm cocks, pressure gauges and hydraulic alarms, etc. The direction of rotation of the main stop valve spindle and the "OPEN" and "SHUT" indicators attached thereto must also conform to the above requirements. The stop and alarm valves shall be flanged.

An electrically operated booster pump shall be included and hydraulically coupled through the control valves for the purpose of boosting the pressure in the sprinkler system after alarm tests have been carried out, except where the water supply is dependent on a pumping system in which case a booster pump will form part of the pumping installation.

The capacity of the pump shall be not less than 9 litres per minute and it shall be capable of boosting the pressure in the installation to not less than 150 kPa above the maximum available water pressure.

The pump shall be provided with both a stop valve and a non-return valve on the delivery side and also a stop valve on the suction side.

The necessary electrical supply in the form of a 15 amp standard plug and switch will be provided by the Department in the sprinkler valve cupboard.

Provision shall be made for both manual and automatic starting and stopping. The latter shall be activated by means of a pressure switch. An amber flashing light, which will flash while the pump is operating, shall be installed in a suitable position above the control valve cupboard.

Where there is more than one sprinkler control valve in the same valve cupboard, each shall be served by a separate booster pump.

7. PRESSURE GAUGES

The two pressure gauges required for the installation shall be not less than 100 mm diameter with porcelain faces registering 1 500 kPa. They shall be so connected to the control valves that one registers the pressure in the municipal supply and the other the pressure in the system.

Their connections shall be taken from purpose made outlets on the valves and shall comprise a "U" tube without any fittings (elbows etc.) with all bends neatly executed. The gauges shall be fitted upright with brass shut-off cocks or other approved means of shut-off so as to permit their removal under pressure, if required.

8. HYDRAULIC ALARMS

In order to ensure smooth operation of the alarm, it shall be provided with grease packed ball races or self-lubricating sleeve type bearings. Full details shall be provided with the tender.

9. MATERIALS

All piping, fittings and valves used in the installation shall be new and of an approved type capable of withstanding a test pressure of 2 000 kPa.

All piping shall be non-galvanised mild steel manufactured in accordance with SABS 62 (medium grade), unless otherwise specified and shall be of an approved brand and the best obtainable. All pipes shall be free of rust, flakes or other faults.

Notwithstanding the above stipulations, all underground pipes shall be galvanised in accordance with SABS 763.

10. PIPE JOINTS

All threaded pipe joints shall be made with an approved cold water pipe-jointing compound and flanges when used shall be bolted together with approved gaskets. Pipe threads shall be standard right-hand Whitworth. Mechanical pipe-joints i.e. "Klambon" or other pipe joints approved by the Department may be used provided they have been approved by the Automatic Sprinkler Inspection Bureau (A S I B) and are installed strictly in accordance with the instructions of the manufacturer.

11. WELDING

Welding in situ without the prior permission of the Department will not be permitted. If welding of any joint or joints is necessary on the site the reasons for this shall be clearly stated in the tender. Welded joints shall be properly machined and the use of a welding torch for making holes shall not be permitted.

Distribution pipes with welded crosses and tees shall be provided with female thread so that the branch pipes can be connected in the conventional way. Where pipe lengths exceed 14m they shall be fitted with flanges.

All welded joints shall be hydraulically tested to 2 000 kPa. Welded joints in branch pipes will not be permitted.

12. PREVENTION OF AIR LOCKS

In order to prevent the lodgement of air, a proper inclination of pipelines shall be maintained throughout the work.

13. DRAINS AND DRAIN COCKS

Suitable drainpipes shall be provided for the 50mm outlet on the control valves and the 32mm outlet on the hydraulic alarms.

Where distribution pipes are lower than the control valves, each separate section of the system shall be provided with a 20mm drain pipe. The pipe shall be properly secured to the wall and roof and carried down and plugged within 2 metres of the floor.

14. SLEEVES AND PIPE SUPPORTS

Where sleeves and/or pipe supports are shown on the Departmental drawings, these will be provided by others.

All pipe supports, clamps and other suspension fittings shall be supplied and installed by the sprinkler contractor. Distribution and branch pipes shall be properly secured and branch pipes shall be anchored within 0,7m from the last sprinkler head.

The Tenderer is required to provide a drawing showing full details of the sizes and manner of the suspension fittings, to the Department for its approval.

15. SPRINKLERS

All sprinklers which the contractor intends using shall be approved by the Automatic Sprinkler Inspection Bureau (A S I B).

Unless otherwise specified in the Supplementary Specification the temperature rating of the sprinklers shall conform with clause 4030.

The sprinkler shall not be older than two years at the date of installation. The date of manufacture of the sprinklers intended to be used, shall be stated in the tender.

16. HEAT COLLECTORS

Where, for any reason whatsoever, it is necessary to install sprinklers under a roof or ceiling at a level lower than that permitted by the "Rules", heat collectors shall be provided.

The heat collectors shall be 500mm x 500mm of 3mm mild steel and securely fixed.

17. STACKING HEIGHT INDICATORS

Stacking height indicators shall be provided wherever the maximum stacking height differs from the general maximum stacking height of 4 metres for ordinary hazard protection.

Such indicators shall be in 50mm red letters on a white background on a steel or aluminium plate. The bottom of the indicating plate shall be fixed 1,5 metres above the floor level.

Where a restriction is applicable to certain materials, which are normally stored in a protected area, such as wood or rubber products, the restrictions regarding the particular product shall be indicated.

It is also necessary to indicate the restrictive heights in 15mm wide red stripes, around all columns and on all walls at distances not more than 15m apart. The applicable height shall be indicated at the stripes in 50mm red letters, as follows: "3m" or "6m" depending on the applicable standards.

18. BLOCK PLAN

The block plan should be in black engraved letters on white perspex or stainless metal plate such as aluminium or stainless steel.

The block plan shall indicate only the buildings protected by the systems, which are served by the control valve or -valves in the particular valve cupboard. Should a building be served by valves in more than one valve cupboard, the block plan shall be provided in all valve cupboards with a clear indication of the position of the particular valve cupboard.

19. ALARM BELL DRAIN PIPES

The drainpipes of each alarm bell shall be taken to a point where the discharge will not cause any damage.

Where there is more than one control valve in the valve cupboard the drainpipes shall be kept completely separate up to the point of discharge.

20. TESTING

The sprinkler installation shall be tested to a hydraulic pressure of 1 000 kPa and any defect made good.

21. PAINTING

Painting of all portions of the sprinkler installation, including all hangers, valves and hydraulic alarms shall form part of the sprinkler contract.

Before painting is undertaken, all work shall be thoroughly cleaned of rust, scale, etc., by brushing with a stiff wire brush wherever necessary. A prime coat of high-quality zinc chromate primer shall be applied before delivery to the site. After installation, all fittings shall also be primed with zinc chromate primer and where the primer has come off the pipes, these shall be re-primed whereafter two coats of high gloss paint shall be applied. Unless otherwise specified, the colour of the high gloss paint shall be similar to No. D 30 Post Office red of CKS 279. The final coat of paint shall be applied only after the system has been tested and the ceilings have been painted. The final coat shall not be applied without the express consent of the Engineer. Pipe supports and other fittings, which are not directly in contact with the pipe work, shall be painted the same colour as the ceilings or beams. The Engineer is to be consulted in this regard.

The hydraulic alarm shall be painted with a prime coat and two coats of high gloss red paint as stated above. The words 'FIRE' and 'BRAND' shall appear thereon in white letters, 100mm in height.

Should the construction of the alarm be such that it is impossible or difficult to paint the letters thereon, these shall be painted on a suitable steel plate and attached to the wall in a clearly visible position.

22. SPARE SPRINKLERS

Spare sprinklers together with an approved sprinkler key, shall be provided in an approved cabinet fitted with an approved lock and two keys and the whole neatly mounted alongside the control valves in the cupboard.

The number of spare sprinklers to be provided shall be in accordance with Clause 4040 of the rules and regulations (latest edition) as laid down by the Automatic Sprinkler Inspection Bureau (A S I B).

23. FRAMED INSTRUCTIONS

A diagrammatic instruction chart clearly indicating the procedure for operating the sprinkler valves, in both official languages, shall be mounted in a strong teak or approved metal frame with Perspex front on the inside of the door to the valve cup-board. The minimum design pressure of the system shall be clearly indicated on the chart.

24. OPERATING AND MAINTENANCE INSTRUCTIONS

Full installation operating and maintenance instructions shall be supplied in triplicate with each system and shall include schematics and detailed wiring drawings with a full component list indicating not only component values but sources of supply. Equipment will not be accepted until this information has been handed to the Department.

25. CUTTING OF PIPES

Contractors using conventional pipe cutters are warned that all burrs and lips are to be removed by proper reaming of the cut end before threading to ensure that the original diameter is obtained. Any pipes with ends of reduced diameter found on the site shall be removed and the Contractor may be required to dismantle completed work so as to convince the Department that no such pipes were used elsewhere in the installation.

26. INSPECTION AND MAINTENANCE

Tenderers shall provide and allow for a full inspection of the sprinkler installation by the Automatic Sprinkler Inspection Bureau (A S I B) or any other organisation recommended or approved by the Department, before the date of the initial taking over of the system.

Tenderers shall also provide and allow for three complete inspections with alarm tests every three months and for alarm tests only during the other eight months of the period of free maintenance, as specified in clause 23 of P W 60.

All such inspections and tests shall be carried out by the Automatic Sprinkler Inspection Bureau (A S I B) and not by the Contractor.

27. INFORMATION REQUIRED WITH TENDER

Tenderers shall supply the information as requested in the Schedule of Equipment and Materials which is attached to this specification as an annexure, together with their tender.

Should a Tenderer fail to do so his tender may be disqualified.

28. MAINTENANCE CONTRACT

After the completion of the required maintenance period the Department may insist on entering into a comprehensive maintenance contract with the installer for a period which may vary between one and five years at the sole discretion of the Department.

ANNEXURE A TO THE STANDARD TECHNICAL SPECIFICATION FOR AN AUTOMATIC SPRINKLER
INSTALLATION

SCHEDULES OF EQUIPMENT AND MATERIALS

Item No. 1	Sprinklers
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- (a) Make _____
- (b) Country or origin _____
- (c) Date of manufacture _____
- (d) Material _____
- (e) Approved by _____

Item No. 2	Piping	Fittings
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- (a) Make _____
- (b) Country of origin _____
- (c) Quality _____

Item No. 3	Hydraulic Alarm
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- (a) Make _____
 - (b) Country of origin _____
 - (c) Approved by _____
 - (d) Material of body _____
 - (e) Material of turbine _____
 - (f) Diameter of turbine _____ mm
 - (g) Type of bearings _____
 - (h) Method of lubrication _____
 - (i) Diameter of gong _____
 - (j) Material of gong _____
 - (h) Mass of alarm complete _____ kg
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Item No. 4	Stop Valve	Alarm Valve
(a)	Make _____	
(b)	Country of origin _____	
(c)	Approved by _____	
(d)	Material of body _____	
(e)	Material of moving parts _____	
(f)	Type of seat _____	
(g)	Hydraulic test pressure _____	kPa _____
(h)	Mass _____	kg _____

Item No. 5	Booster Pump and Motor
(a)	Make of pump _____
(b)	Country of origin of pump _____
(c)	Make of motor _____
(d)	Country of origin of motor _____
(e)	Type of motor and number of phases _____
(f)	Rated power of motor _____ KW
(g)	Pumping yield at 20m head _____ l/m
	25m head _____ l/m
(h)	Material of casing _____
(i)	Material of impellers _____
(j)	Number of impellers _____
(k)	Type of glands _____
(l)	Type of bearings in pump and motor _____
(m)	Make and type of starter _____
(n)	Maximum starting current.amp _____
(o)	Amperage at full load.amp _____
(p)	Total mass of pump and motor _____ Kg