

SECTION D:

**PARTICULAR SPECIFICATION FOR PORTABLE FIRE
EXTINGUISHER BOOSTED HOSE REEL SYSTEM, DRY
RISER, FIRE HYDRANT INSTALLATIONS AND FIRE
SPRINKLER SYSTEM**

1.0 PORTABLE FIRE EXTINGUISHER AND HOSE REEL INSTALLATIONS

1.1 General

The particular specification details the requirements for the supply and installation and commissioning of the Portable Fire Extinguishers, Hose Reel, Fire Hydrant and Dry Riser. The Sub-contractor shall include for all appurtenances and appliances not necessarily called for in this specification or shown on the contract drawings but which are necessary for the completion and satisfactory functioning of the works.

If in the opinion of the Sub-contractor there is a difference between the requirements of the Specifications and the Contract Drawings, he shall clarify these differences with the Engineer before tendering.

1.2 Scope of Works

The Sub-contractor shall supply, deliver, erect, test and commission all the portable fire extinguishers, Hose Reel, Fire Hydrant and Dry Riser which are called for in these Specifications and as shown on the Contract Drawings.

1.3 Water/CO2 Extinguishers

These shall be 9-litre water filled CO2 cartridge operated portable fire extinguishers and shall comply with B.S. 1382: 1948 and to the requirements of B.S.4523: 1977. Unless manufactured with stainless steel, bodies shall have all internal surfaces completely coated with either a lead tin, lead alloy or zinc applied by hot dipping. There shall be no visibly uncoated areas.

The extinguishers shall be clearly marked with the following:

- a) Method of operation.
- b) The words 'WATER TYPE' (GAS PRESSURE) in prominent letters.
- c) Name and address of the manufacturer or responsible vendor.
- d) The nominal charge of the liquid in imperial gallons and litres.
- e) The liquid level to which the extinguisher is to be charged.
- f) The year of manufacture.
- g) A declaration to the effect that the extinguisher has been tested to a pressure of 24.1 bar (350 psi.).
- h) The number of British Standard 'B.S' 1382 or B.S. 5423: 1977.

1.4 Portable Carbon Dioxide Fire Extinguishers

These shall be portable carbon dioxide fire extinguishers and shall comply with B.S. 3326: 1960 and B.S. 5423: 1977.

The body of extinguisher shall be a seamless steel cylinder manufactured to one of the following British Standards; B.S. 401 or B.S. 1288.

The filling ratio shall comply with B.S. 5355 with valves fittings for compressed gas cylinders to B.S.341. Where a hose is fitted it shall be flexible and have a minimum working pressure of 206.85 bar (3000 p.s.i.). The hose is not to be under internal pressure until the extinguisher is operated.

The nozzle shall be manufactured of brass gunmetal, aluminium or stainless steel and may be fitted with a suitable valve for temporarily stopping the discharge if such means are not incorporated in the operating head.

The discharge horn shall be designed and constructed so as to direct the discharge and limit the entrainment of air. It shall be constructed of electrically non-conductive material.

The following markings shall be applied to the extinguishers:-

- a) The words "Carbon Dioxide Fire Extinguisher" and to include the appropriate nominal gas content.
- b) Method of operation.
- c) The words "Re-charge immediately after use".
- d) Instructions for periodic checking.
- e) The number of the British Standard B.S. 3326: 1960 or B.S. 5423.
- f) The manufacturers name or identification markings

1.5 Dry Chemical Powder Portable Fire Extinguisher

The portable dry powder fire extinguishers shall comply with BS3465: 1962 and BS 5423. The body shall be constructed to steel not less than the requirements of BS 1449 or aluminium to BS 1470: 1972 and shall be suitably protected against corrosion.

The dry powder charge shall be not-toxic and retain its free flowing properties under normal storage conditions. Any pressurizing agent used as an expellant shall be in dry state; in particular compressed air.

The discharge tube and gas tube if either is fitted shall be made of steel, brass, copper or other not less suitable material. Where a hose is provided it shall not exceed 1,060mm and shall be acid and alkali resistant. Provision shall be made for securing the nozzle when not in use.

The extinguisher shall be clearly marked with the following information

- a) The word "Dry Powder Fire Extinguisher"
- b) Method of operation in prominent letters.
- c) The working pressure and the weight of the powder charge in Kilogramme.
- d) Manufacturers name or identification mark
- e) The words "RECHARGE AFTER USE" if rechargeable type.
- f) Instructions to regularly check the weight of the pressure container (gas Cartridge) or inspect the pressure indicator on stored pressure types when fitted, and remedy any loss indicated by either.
- g) The year of manufacture.
- h) The Pressure to which the extinguisher was tested.
- i) The number of this British Standard BS 3465 or BS 5423: 1977.
- j) When appropriate complete instructions for charging the extinguisher shall be clearly marked on the extinguisher or otherwise be supplied with the refill.

1.6 Air Foam Fire Extinguisher

These shall be of 9 litres capacity complete with refills cartridges and wall fixing brackets and complying with B.S. 5423 with the following specifications:-

Cylinder:	to B.S. 1449
Necking:	to be 76mm outside diameter steel EN 3A 2 ³ / ₄ X 8TPI female thread.
Head cap:	to be plastic moulding acetyl resin.
CO₂ Cylinder:	to be 75gm P.V.C coated.
Internal Finish:	to be polythene lining on phosphate coating.
External finish:	to be phosphated - One coat primer paint and one coat stove enamel B.S. 381 C.

1.7 Fire Blanket

The fire blanket shall be made from cloth woven with pre-asbestos yarn or any other fire proof material and to measure 1800 x 1210 mm and shall be fitted with special tapes folded so as to offer instantaneous single action to release blanket from storing jacket.

2.0 Boosted Hose Reel System

2.1 General

The Particular Specification details the requirements for the supply, installation and commissioning of the hose reel installation. The hose reel installation shall comply in all respects to the requirements set out in C.O.P 5306 Part 1: 1976, B.S 5041 and B.S 5274. The System shall comprise of a pumped system.

2.2 Hose Reel Pumps

The fire hose reel pumps shall consist of a duplicate set of multi-line centrifugal pumps from approved manufacturers. The pumps shall be capable of delivering 0.76 lit/sec at a running pressure of 2 bars.

The pump casing shall be of cast iron construction with the impeller shaft of stainless steel with mechanical seal.

2.3 Control Panel

The control panel shall be constructed of mild steel 1.0mm thick sheet, be moisture, insect and rodent proof and shall be provided complete with circuit breakers and a wiring diagram enclosed in plastic laminate.

The pump shall be controlled by a flow switch therefore; the control panel shall include the following facilities:

- (a) 'On' push button for setting the control panel to live.
- (b) Green indicator light for indicating control panel live.
- (c) Duty / Stand-by pump auto change over.
- (d) Duty pump run green indicator light.
- (e) Stand-by pump run green indicator light.
- (f) Duty pump fail red indicator light.
- (g) Stand-by pump fail red indicator light.
- (h) Low water condition pump cut-out with red indicator light.

The pumps are to be protected by a low level cut-out switch to prevent dry pump run when low level water conditions occur in the water storage tank.

2.3.1 Hose Reel

The hose reel to the installation shall consist of a recessed, swing-type hose reel as Angus Fire Armour Model III or from other approved manufacturers.

The hose reel shall comply with B.S. 5274: 1975 and B.S 3161: 1970 and is to be installed to the requirements of C.P. 5306 Part 1: 1976.

The hose reel shall be supplied and installed complete with a first-aid Non-kinking hose 30 meters long with a nylon spray / jet / shut-off nozzle fitted. A screw down chrome - plated globe valve to B.S 1010 to the inlet to the reel is to be supplied. The orifice to the nozzle is to be not less than 4.8mm to maintain a minimum flow of 0.4 lit / sec to jet.

The hose reels shall be installed complete with electro-galvanized cabinet recessed on the wall.

The hose reels shall be installed at 1.5 meters centre above the finished floor level in locations shown in the contract drawings.

2.3.2 Pipe Work

The pipe work for the hose reel installation shall be galvanized wrought steel tubing heavy grade Class B to B.S 1387: 1967 with pipe threads to B.S 21. The pipe work and all associated fittings shall be in approved colour for fire fittings.

2.3.3 Pipe Fittings

The pipe fittings shall be wrought steel pipe fittings, welded or seamless fittings conforming to B.S. 1740 or malleable iron fittings to B.S 143.

All changes in direction will be with standard bends or long radius fittings. No elbows will be provided.

2.3.4 Non-return Valves

The non-return valves up to and including 80mm diameter shall be to B.S. 5153: 1974.

The valves shall be of cast iron construction with gunmetal seat and bronze hinge pin.

2.3.5 Gate Valves

The gate valves up to and including 80mm diameter shall be non-rising stem and wedge disc to B.S 5154: 1974 with screwed threads to B.S. 21 tapes thread

2.3.6 Sleeves

Where pipe work passes through walls, floors or ceilings, a sleeve shall be provided one diameter larger than the diameter of the pipe, the space between them to be packed with mineral wool, to the Engineer's approval.

2.3.7 Earthing

The hose reel installation shall be electrically earthed by a direct earth connection.

The installation of the earthing shall be carried out by the Electrical Sub- contractor.

2.3.8 Finish Painting

Upon completion of testing and commissioning the hose reel installation, the pipe work shall be primed and finish painted with 2 No. coats of paints to the Engineer's requirements.

2.3.9 Testing and Commissioning

The hose reel installation shall be flushed out before testing to ensure that no builder's debris has entered the system. The installation is to be then tested to one and half times the working pressure of the installation to the approval of the Engineer. Simulated fault conditions of the pumping equipment are to be carried out before acceptance of the System by the Engineer.

2.3.10 Instruction Period

The Sub-contractor shall allow in his contract sum for instructing of the use of the equipment to the Client's maintenance staff. The period of instruction may be within the contract period but may also be required after the contract period has expired.

The period of time required shall be stipulated by the Client but will not exceed two days in which time the Client's staff shall be instructed on the operation and maintenance of the equipment.

2.0 Signage-Fire Instruction /Fire Exit

2.1 Fire Instruction Notice

Print fire instruction on the Perspex plates with White Colour Background measuring 510mm length x 380mm width x 4mm thick as follows;

<p style="text-align: center;">FIRE INSTRUCTION NOTICE</p> <p style="text-align: center;">In the event of fire;</p> <ol style="list-style-type: none">1. Raise the alarm by actuating the nearest alarm system point, Sound Siren /gong or Shout Fire2. Attack fire using the nearest available equipment3. Call nearest fire Brigade or Police 999 and inform your switchboard (PABX) Operator4. Ensure that all personnel not involved in fire fighting evacuation to safety outside the building.5. Close but DO NOT LOCK doors behind as you leave.6. Evacuate the building using stairs or fire escapes. Do not use Lifts/escalators. Walk calmly. Avoid panic. Do not stop or return for personal belongings.7. Assemble as per floor outside the building for roll call.
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2.1.1.1 Fire Exit Sign

Print Fire Exit signs on the Perspex plate, 4mm thick, with white colour background as follows:-

1. Lettering **IN RED COLOR** of not less than 50mm in height.
2. A pendant sign bearing words, **FIRE EXIT** and with a directional arrow.

The sign must be capable of being read from both approaches to exit and so is double sided.

2.1.1.2 Hose Reel Label

Print Fire Exit signs on the Perspex plate, 4mm thick, with white colour background as follows:-

1. Lettering **IN RED COLOR** of not less than 50mm in height.
2. A pendant sign bearing words, **HOSE REEL** and with a directional arrow.

The sign must be capable of being read from both approaches to exit and so is double sided.

4.0 The Dry Riser Installation

4.1 Definition

Dry riser installation is a system where a pipe is installed vertically through a building with an inlet breeching provided at a street level through which the fire brigade can pump water.

4.2 Installation

The dry riser is installed with Fire Brigade Breeching inlet installed at street level in front of the building at a position where fire brigade can access and pump water into the building. Landing valves are then installed on each floor above the ground level to which the fire brigade can attach fire fighting hoses.

4.3 Landing Valves

The Hydrant outlets shall comply with the requirements of C.P 5306 Part 1:1976 and B.S 5041 Part 1. The hydrant Riser outlets shall be 2No minimum per floor including the roof and shall be mounted with their centre line between 910mm and 1060mm above finished floor level positioned at the entry lobby on each floor.

4.4 Fire Brigade Breeching Inlets

One of the Brigade Breeching inlets shall consist of four (4No.) 64mm internal diameter instantaneous male coupling for connection to the fire brigade pumps and other two shall consist of two (2No.) 64mm internal diameter instantaneous male coupling.

The breeching inlet shall incorporate a 100mm diameter flanged connection to the 100mm dry riser mains.

The breeching inlet shall be located 1000mm to the centre line of the box above ground level.

The breeching inlet shall be enclosed in a galvanized mild steel cabinet of suitable dimensions to contain all visible pipe work. A 7.5mm thick wired glass front shall be provided with 50mm high, red lettering, **DRY RISER BREECHING CONNECTOR**. The remainder of the box is to be finished in fire red enamel paint.

4.5 Pipework

The pipe work fittings shall be wrought steel pipe fittings welded or seamless fittings conforming to B.S 1740 Part 1971 or malleable iron fittings to B.S 193.

All changes in direction will be standard bends or long radius fittings. **No elbows will be permitted.**

4.6 Flanges

The flanges shall comply with B.S 4504:1969. All flanges shall comply with a nominal Pressure Rating of 16 bars and shall be of either grey cast iron or steel.

4.7 Gaskets

The gaskets for use with flanges to B.S 4504: 1969 shall comply with B.S 4865 Part 1: 1972 for pressure up to 64 bars.

4.8 Air Relief Valves

The dry riser shall terminate 1M above the roof landing valve with an air relief valve. The valve construction shall be of iron Grade E conforming to B.S 1452. Float Guide and Seat Ring shall be of A.B.S plastic with seal ring of moulded rubber, Maximum working pressure of the valve is to be 16 bar.

4.9 Non-Return Valves

The non-return valves up to and including 80mm diameter shall conform to B.S 5153:1974 with flanges to B.S 4504 PN 16. The valves shall be of cast iron construction with gunmetal seat and disc with spring of phosphor bronze.

Non return valves exceeding 80mm diameter and up to 300mm diameter shall be conform to B.S 5153:1974 with flanges to B.S 4504 PN 16. The valve shall be in Cast Iron Construction with Gunmetal seat to B.S 1400.

4.10 Gate Valves

The gate valves up to and including 80mm shall be non rising stem and wedge disc to B.S. 1952:1964 (B.S 5154:1974) with screwed threads to B.S.21(KS ISO 7 – 1) taper thread. The valves shall be of high grade bronze construction.

Gate valves exceeding 80mm and up to 300mm shall be to B.S 5163 with flanges to B.S 4504 PN 16. The valve is to be double flanged cast iron wedge gate valve for water works purposes with cast iron body to B.S 1452 GRADE 14 with rubber covered cast iron gate. The stem is to be of Forged Stainless Steel to B.S 970 with cast iron hand wheel.

4.11 Sleeves

Where Pipework pass through walls or floors or ceiling a sleeve shall be provided one diameter larger than the diameter of the pipe the space between to be the packed with mineral wool, to the Engineers approval.

4.12 Floor and Ceiling Plates

Where pipes pass through floors, walls and ceilings, floor, wall and ceilings plates shall be secured around the pipe. The plated shall be of stainless steel construction and will serve no other purpose than to present a neat finish to the exposed installations.

4.13 Earthing

The dry riser shall be electrically earthed by a direct earth connection. The installation of the earthing to be carried out by the electrical Sub-Contractor

4.14 Finish Painting

Upon completion, testing and commissioning of the dry rise installation the pipe work shall be primed and finish painted with 2No. Coats of paint by the Sub-Contractor to the Engineer's requirements.

4.15 Testing and Commissioning

The installation is to be tested to one and half times the working pressure of the installation, all to the approval of the Engineer. The pressure shall be maintained for about 1 hour ensuring that there is no change in pressure is observed

4.16 Canvas Hose

The canvas hose shall be 65mm diameter 30m long designed for a bursting pressure of 34 bars. The canvas hose shall have attached instantaneous hose coupling, branch pipes and nozzle to B.S 336: 1965.

4.17 Hose Cradle

The hose cradle shall be a high quality fitting designed for use in public buildings. The cradle **shall be made in aluminium** throughout and shall be supplied with a wall bracket and the finish shall be polished or chrome plated

5.0 Fire Hydrant

5.1 Fire Hydrant Details

5.1.1 Definition

The fire hydrant is a system which is installed along the water mains to used as a means of providing water to the fire brigades through the connection of the hose from a stand pipe.

5.1.2 Installation

The fire hydrants are installed along the water mains with the first hydrant at a location which is not more than 60 m from the entry of any building and they should not be more than 120 m apart.

5.1.3 Hydrant body

The body of the hydrant shall be made of grey cast iron complying with the requirements of BS 1452 having a tensile strength not less than that given for grade 14.

5.1.4 Hydrant Valve

The valve shall be faced with suitable resilient material. The threaded part of the valve, which engages with the spindle, shall be of bronze.

Body seating for the valves shall be of copper alloy complying with the requirements of BS 1400 (KS 06 – 744 – 1:1991) or high tensile brass complying with the requirements of BS 2872 or BS 2874.

Turning the spindle cap in a clockwise direction when viewed from above shall close valves and the direction of opening shall be permanently marked on the gland.

5.1.5 Spindle & Spindle Cap

The spindle note shall be either of the same material as the spindle, or of copper alloy complying with the requirements of BS 1400 (KS 06 – 744 – 1:1991). It shall have a squared top formed to receive either a cast iron spindle cap.

The spindle shall be made of copper alloy complying with the requirements of BS 2874 (KS 06 – 744 – 1:1991), and it shall have a threaded machined of trapezoidal form. The spindle cap shall be of a cast iron secured to the spindle by on M12 hexagon socket set screw conforming to BS 4168.

5.1.6 Hydrant Outlet

The outlet flange of the hydrant shall have above nominal diameter 65mm, and shall be fitted with a screwed outlet – Both flanges shall be 50 mm conforming to BS 4504: Part 1: 1969

The screwed outlet shall be provided with a cap of cast iron or other suitable material. The cap shall cover the outlet thread completely and shall be attached to the hydrant by a chain

The distance between the axis of the outlet and the nearest point on the spindle fitting shall be not less than 100 mm.

The screwed outlet shall be made of Copper alloy to BS 1400 (KS 06 – 744 – 1:1991), or Copper alloy to BS 2872, or Suitable Spheroidal graphite iron to BS 2789 protected against corrosion accordance with CP 2008.

5.1.7 Drain Boss

Each shall be provided with a suitable drain boss on the outlet side. This shall be located at the lowest practical point which will permit the filling of self-operating a drilled drip plug.

5.1.8 Jointing

The hydrants shall have machined joint faces through out and the fitting of adjoining parts shall be such as to make sound joints, corresponding parts of hydrants of the same design and manufacture shall be interchangeable.

5.1.9 Hydrant coating

The hydrant shall be coated in accordance to BS. 4164.

5.1.10 Surface Box

The clear opening of hydrant surface boxes at ground level shall not be less than 250mm x 380mm.

The depth of frame shall normally be:

- a) For boxes located on footpaths: 100mm
- b) For boxes located in roads: 125mm

5.1.11 Marking

Surface box covers shall be clearly marked by having the words ‘**FIRE HYDRANT**’ in letter not less than 30mm high, or the initials ‘**FH**’ in letters not less than 75mm high cost into the cover.

5.1.12 Surface Box Covers & Frames

The surface box frames and covers shall be graded in accordance with BS 497:1967 and shall meet the loading test requirement also given in BS 497

5.2 Stand Pipes

One end of these shall have internal threads to couple with the 80mm diameter external threads of the screw down type or above ground fire Hydrant (BS 750 type 2 hydrants) outlet. It shall have 65mm diameter internal threads to couple with the interconnect or hose of the pump set

5.3 Hose Pipe

Each cotton synthetic fibre rubberized fire hosepipe to be at least 30 metres long with 65mm diameter female instantaneous type connector complete with nozzle.

5.4 Testing

The hydrants shall be deemed to have undergone the necessary hydrostatic and flow test at time of manufacture. Necessary test certificates from the manufacturer shall be needed. The test, to conform to BS 750: 1977:

SECTION E

**PARTICULAR SPECIFICATION FOR
FIRE SUPPRESSION SYSTEMS**

GENERAL SPECIFICATIONS FOR FIRE SUPPRESSION SYSTEM

1.1 General

The specifications described here make reference to FM 200 fire suppression system. However, alternative systems utilizing inert gases may be used subject to the condition that they meet all the requirements of this specification.

The FM 200 shall be used to extinguish fires in the rooms to be specified.

The gas shall be stored under pressure in liquefied form inside cylinders and piped to fire protected areas. Each FM 200 system in a given zone shall be supplied complete with its control Unit that shall receive the signal from smoke detectors or break glass and automatically release the gas after sounding an alarm bell and switching off any existing Ventilation systems . The fire detection system in all areas where FM 200 gas system is not installed shall be supplied and installed by, but the Sub-Contractor shall liaise with him and extend detection signal outputs into the Master Alarm Control Panel.

The Design, equipment, installation, testing and maintenance of the system shall be made in accordance with these specifications, drawings and the following standards:

- a) **NFPA 2001-Clean Agent Fire Extinguishing systems**
- b) **NFPA 70-National Electrical Code**
- c) **NFPA 72-National Fire Alarm Code**
- d) **Local authority requirements**

The fire suppression systems shall be designed by competent personnel who are trained and authorized by the equipment manufacturer for design of total flooding FM 200 systems and the integrated detection systems. Working Drawings shall be provided in sufficient detail to indicate the type, size, and arrangement of component materials and devices; and the dimensions needed for installations and correlation with other materials and equipment.

All Working Drawings shall be submitted for review and approval prior to installation.

Detailed literature outlining the operation, recharge and service of the system, Maintenance procedures for the owner shall be provided.

Equipment manufacturer shall provide a **12 month** warranty Details of this warranty shall be furnished upon request.

All devices, components and equipment shall be products of the same manufacturer and shall be U.L listed or FM approved.

1.1 SYSTEM ARRANGEMENT

FM 200 fire suppression system shall be of the engineered, permanently piped, fixed nozzle type with all pertinent components of the same manufacturer. All agent storage containers shall be centrally located as vertical, free-standing cylinders with wall mounted retaining brackets. Where multiple cylinders are required for the same hazard, a common manifold should be employed.

Manifolds shall be constructed from seamless schedule 80 piping. They shall be complete with a safety relief valve. Manifolged cylinders shall employ a flexible discharge hose to facilitate installation and system maintenance. Each cylinder on a manifold shall also include an agent check valve installed to the manifold inlet.

Where a set of manifolded cylinders shall be required to serve multiple zones, selector valves shall be used to direct the extinguishing agent to the respective zone.

Detection system shall be of the engineered type, suitable for direct interface with the FM 200 fire suppression system. Detectors shall be wired in Sequential Detection method of operation or standard Cross-Zoned detection.

For each hazard, both Ionization and Photoelectric type smoke detectors shall be used to provide automatic input to the control panel.

In addition, manual pull station(s) shall be provided for the direct electric release of the FM 200 Fire Suppression System.

Automatic operation of each protected area shall be as follows:

- a) Actuation of one (1) detector, within the system to:
 - i) Illuminate the "ALARM" LED on the control panel face.
 - ii) Energize the audible notification appliances within the protected space with a unique pattern to indicate a first alarm condition
 - iii) Transfer sets of 5 Amp rated auxiliary contacts which can perform auxiliary system functions such as: Operate door holder/closures on access doors, Transmit a signal to the fire alarm system, Shutdown HVAC equipment, etc
 - iv) Light an individual LED on an optional graphic annunciator.

- b) Actuation of a 2nd detector, within the system, to:
 - i) Illuminate the "PRE-DISCHARGE" LED on the control panel face; energize the audible notification appliances within the protected space with a unique pattern to indicate a second alarm (pre-discharge) condition, Shut down the HVAC system and/or close dampers, Start time-delay sequence (not to exceed 60 seconds), enable System abort sequence, Light an individual LED on a graphic annunciator.

 - ii) After completion of the time-delay sequence, the system shall activate and the following shall occur: Illuminate a "RELEASE" LED on the control panel face, Energize the audible notification appliances within the protected space with a continuous on pattern to indicate a release condition, Shutdown of all power to high-voltage equipment, Energize a visual indicator(s) outside the hazard in which the discharge occurred, Energize a "System Fired" audible device.

The system shall be capable of being actuated by manual discharge devices located at each hazard exit. Operation of a manual device shall duplicate the sequence description above except that the time delay and abort functions SHALL be bypassed. The manual discharge station shall be of the electrical actuation type and shall be supervised at the main control panel.

1.2 DESIGN PARAMETERS – FM 200

Design of the total flooding FM 200 system shall be based upon the enclosure being sufficiently tight against agent leakage with all ventilation shut down and or fire dampered or provide for static air condition upon discharge.

Agent quantity calculations shall be determined from dimensions furnished on the construction drawings and or in the particular specification using a design concentration based on fire hazard class of the protected zone and the NFPA 2001 standards. As a minimum a concentration of 38% at the minimum anticipated hazard temperature of 20 ° C shall be used.

Calculation for the maximum design concentration shall be based upon maximum anticipated hazard temperature of 32 ° C.

When applicable, agent quantity shall be adjusted for:

- i) Altitudes of more than (915m) above sea level.
- ii) Non-flooded false ceiling volume.
- iii) Multiple hazards from a common agent supply.
- iv) Manufacturer standard tanks and fill increments
- v) Duct volume for HVAC system.

The system shall be designed to discharge the calculated agent quantity in a nominal 60 second period.

Nozzle spacing shall be in accordance with the listed approved coverage for each nozzle type. In all cases, the need for additional nozzle shall be considered based upon site conditions and manufacturer's recommendations.

Hydraulic calculations for each system shall be used upon two-phase flow equations for unbalanced systems as defined by **NFPA** regardless if a single nozzle or balanced piping network is used.

Computerized verification of hydraulic calculations shall be submitted for each FM 200 system.

The contractor shall provide data to indicate the free venting area required per **NFPA standards** for each hazard volume.

1.2.1 DESIGN PARAMETERS – DETECTION

The design of the detection/control system shall be based on a clean, vibration free, electrical non-hazardous environment

As a minimum detector spacing shall be based upon **NFPA** recommended practices for ceiling construction, air flow and manufacturer recommendations.

At least one smoke detector of each type (ionization and photoelectric) shall be used in each protected area. Where multiple detectors are used, detection shall alternate such that ionization are adjacent to photoelectric.

Unless otherwise stated on the drawings manual pull station(s) shall be located at all points of exit from the protected area.

Unless otherwise stated on the drawings at least one alarm device shall be located within the protected area for the general alarm function.

Battery capacity shall be sufficient to permit normal non-alarm condition for 24 hours with subsequent general alarm for 5 minutes after loss of primary line power. The contractor shall be required to furnish calculations to back up the battery capacity to be installed.

1.3 EQUIPMENT AND MATERIAL

1.3.1 General

All materials and equipment shall be of new, unused, and undamaged condition in strict accordance with the requirement of this section. Equipment shall be required to meet the specified standards; **ISO 14520, NFPA.**

All equipment's and materials shall only be used for their intended application, in locations for which they were designed, and installed in accordance with the manufacturer's instructions and or recognized standard trade practice.

1.3.2 Pipe Material – FM 200 200 bar System.

FM 200 200 bar system piping shall be of non –combustible materials having physical and chemical characteristics such that its integrity under stress can be predicted with reliability. Materials other than listed below , such as stainless steel or nonferrous piping or tubing , may be used if the materials satisfy the applicable requirements of NFPA.

As a minimum, piping materials and manifolds shall be schedule 40 seamless steel pipes conforming To BS specifications and capable of 65 bar operating pressure (ASTM Grade A-106B). Under no conditions shall ordinary cast iron pipe, steel pipe or non- metallic pipe be used.

FM 200 system piping joints shall be suitable for the design conditions and shall be selected with consideration of joint tightness and mechanical strength.

As a minimum, fittings shall be black class 300 malleable iron fittings. Ordinary cast iron fittings shall not be permitted.

Piping shall be installed accordance with good commercial practice to the appropriate codes, securely supported with Listed hangers, and arranged with close attention to the design layout since deviations may alter the design flow performance as hydraulically calculated.

All Piping must be reamed, blown clear, and swabbed with appropriate solvent to remove mill varnish and cutting oils before assembly. The piping shall also be finished off with two coats of red paint after testing. Multi- outlet fittings other than tees shall not be permitted.

Assembly of all joints shall conform to the appropriate standards. Threaded pipe joints shall utilize Teflon tape applied to male thread s only.

1.3.3 Agent Storage Tank

FM 200 agent storage containers shall be of welded steel construction in accordance with **NFPA** Specification and finished in (baked red enamel) (red epoxy) paint.

Tank assemblies shall be filled with FM 200 pressurized to 200 bar at (15 °C).

Initial filling of the cylinders and recharge shall be done in accordance with the manufacturer's established procedures and shall not require replacements components for normal service.

The size and fill weights of all cylinders shall be of the following nominal sizes: _

- i) 80 litre 22.8kg
- ii) 80 litre 32.1kg

Nominal 270kg tank assembly shall be equipped with an internal liquid level measuring rod, marked in ¼ inch increments to allow direct reading of the liquid level and conversation to the weight of Argon within the tank.

Tank assemblies shall be vertical, free standing modules employing suitable wall mounted retaining brackets. Tank assemblies shall be listed or approved to perform in the temperature range -20C to 50C.

Aluminum **name plates** indicating manufacturer's name and part number , agent fill weight , total charged weight date of fill, shall be permanently bonded to each tank.

Each tank assembly shall have the means to accommodate lifting devices to facilitate weighing removal and replacing.

Tank assembly shall include a pressure gauge and a low pressure switch that operates at approximately 180 bar to facilitate continuous supervision of tank pressure.

1.3.3.1 Tank Valve

Agent storage tank assemblies shall include an integral, high flow valve assembly connected to the tank by a machined thread and sealed by an O-ring.

Valve outlet sizes shall be based on the nominal tank capacity with a one inch size for 18,33,54 and 72 pound assemblies, and three inch for 600 pound assemblies.

The valve design shall be of the differential pressure type which utilizes tank pressure to seal the valve assembly. The valve shall be compatible with separate, removable, stackable type actuators for electric, pneumatic, and or manual actuation. Operation of the valve by the stackable type actuator shall be such actuation.

Operation of the valve by the stackable type actuator shall be such that pressure is relieved from the upper chamber of the valve causing the valve to open. Valves shall be forged brass construction with an o-ring sealed brass spool incorporating the main electrometric seal surface.

The valve assembly shall include recessed pressure gauge 0 to 250 bar, overpressure safety relief disc assembly, normally pressurized connection port for an optional low pressure switch, normally unpressurized connection port used as pneumatic source for a slave cylinder valve actuation, and brass shipping caps on exposed thread connection.

When pneumatically operated main/reserve systems are used, pilot valves shall be equipped with actuation isolators.

All tank valves shall be F.M or LPCB Approved.

1.4.3.2 Tanks Brackets

Each FM 200 tank shall be furnished with a stainless steel, two part, strap type retaining bracket designed to secure the cylinders to the wall or any other suitable surface as may be recommended by the system manufacturer.

1.4.3.3 Valve Actuator system

FM 200 valve actuator system shall consist of a pneumatically operated cylinder actuator assembly and a and a **solenoid type** Electric actuator package.

The solenoid actuator package shall consist of the solenoid valve mounted either on a rechargeable slave nitrogen cylinder or on the Argon gas cylinder. A signal from the control panel shall operate the solenoid valve to discharge the gas in the pilot cylinder. The discharged gas shall then open the cylinder actuator assembly mounted on the FM 200 cylinder discharge valve. This process shall release the stored FM 200 gas for fire extinguishing.

Where multiple zones are protected from the same storage system, selector valves shall be used. These valves shall be actuated by the Nitrogen gas from the actuation package.

Manual override actuators shall be designed to attach to electric actuator or directly to the valve assembly and permit manual operation of the pilot cylinder tank assembly.

Manual actuator positions shall be clearly marked and operating instructions provided.

All actuators shall be LPCB Approved.

1.4.3.4 Discharge Nozzles

FM 200 discharge nozzles shall be of one piece (brass) construction sized to provide flow rates in accordance with system design hydraulics.

Orifice (s) shall be machined in the nozzle body to provide a horizontal discharge in 90⁰, 180⁰, or 360⁰ patterns based upon the approved coverage arrangements.

Separate, interchangeable orifice plates are not acceptable.

Nozzles shall be permanently marked with the manufacturer's part number, number of orifice and orifice code. The nozzle shall be threaded directly to the discharge piping without the use of special adaptors.

Nozzles shall be LPCB Approved.

1.4 Warning Signs

Etched aluminum Warning Signs shall be provided at all Entrance and Exits of the protected area.

Entrance sign shall read: "WARNING DO NOT ENTER ROOM WHEN ALARM SOUNDS, **FM 200** BEING RELEASED."

Exit sign shall read: "WHEN ALARM SOUNDS, VACATE AT ONCE, **FM 200** BEING RELEASED."

1.5 EQUIPEMENT AND MATERIAL –ELECTRICAL

1.6.1 General Materials

All electrical trunkings and conduits shall be employed in accordance with applicable codes and intended use and contain only those electrical circuits associated with the fire detection and control system and shall not contain any circuit that is unrelated to the system.

Unless specifically provided otherwise in each case, all conductors shall be enclosed in steel conduit, rigid or thin walled as conditions dictate, except in computer room where they shall be PVC conduit concealed in building fabrics.

All wiring shall be of the proper size to conduct the circuit current. The use of aluminium wire is strictly prohibited. Splicing of circuits shall be kept to a minimum and are only to be found in an electrical device suited for the purpose. Wire spliced together shall have the same colour insulation. Wire splices shall be made with appropriate devices suited for the purposes.

All wire terminations shall be made with crimp terminals unless the device at the termination is designed for bare wire termination.

All electrical circuits shall be numerically tagged with suitable devices at its terminating point and/ or splice. All circuits numbers shall correspond with the installation drawings.

The use of coloured wires is encouraged. White coloured wire shall be used exclusively for the identification of the neutral conductor of an alternating current circuit.

Green coloured wire shall be used exclusively for the identification of the earth ground conductor of an AC and DC circuit.

1.6.2 Control Panels – General

All control panels shall be F.M Approved and be utilized with listed or approved operating devices and shall be capable of the following features,:

- a. Supervised Detection Circuits (s) with a first stage and a second stage circuit.
- b. Supervised Alarm Circuit allowing for a first stage alarm, second stage alarm and the third stage for gas release.
- c. Supervised Release Circuit
- d. Supervised Manual Electric Pull Circuit
- e. Supervised Manual mechanical Pull Circuit
- f. 0-60 second Programmable Time Delay
- g. Battery Standby
- h. Front Panel Indicating Lamps and 4x20 character display
- i. Key Lock Steel Enclosure with a glass panel covering the controls

The internal power supply shall operate from 240V 50Hz A.C power supply. A fused polarity reversing , 1 amp, 24VDC supervised dedicated release circuit for use with approved fire suppression system releasing devices shall be provided.

The control unit shall provide provisions for housing its own set of “on-line” float charged emergency batteries within the enclosure.; Battery supervision shall be provided for condition and placement of the batteries.

A supervised dedicated manual pull circuit designated for immediate operation of the release circuit shall be provided. An auxiliary trouble circuit for supervision of other normally closed accessory devices shall be provided. The control unit shall be housed in steel cabinet of approved type with conduit knockouts in a (red) (beige) enamel finish.

The control unit shall be F.M or LPCB Approved as an alarm releasing control unit

1.6.3 Smoke Detector - Ionization

Ionization type smoke detector shall be dual chamber type and compatible with the control unit. The detector shall have an LED in its base which is illuminated in a steady “on” mode when in alarm. Reset of the detector shall be performed by the control unit reset switch.

The design of the ionization detector compensating circuits shall provide stable operation with regard to minor changes in temperature, humidity, and atmosphere conditions.

The sensitivity voltage shall be factory set per U.L 268. A special locking screw shall be provided to lock the head to the base; the head to base connection shall be by use of bifurcated contracts. Terminal connections to the base shall be of the screw type. The detector shall be F.M or LPCB Approved.

1.6.4 Smoke Detector - Photoelectric

Photoelectric detector shall be a solid-state sensing chamber unit providing stable operations (sensitivity) and compatible with the control unit. The detector shall utilize a light sensing photodiode and a pulse signal processor to measure the density of the combustion products within

The sensing chamber - The detector head shall have a stainless steel mesh to prevent foreign objects from entering the sensing chamber. The sensitivity voltage shall be factory set.

A special locking screw shall be provided to lock the head to the base. The head to base connection shall be by use of bifurcated contacts. Terminal connections to the base shall be of the screw type.

The detector shall be F.M or LPCB Approved.

1.6.5 Alarm Bells

The vibrating Alarm Bell shall be approved for use with the listed control unit. The polarized alarm bell shall be rated at 24VDC and draw no more than .063 amps and shall contain a series diode for use in supervised systems. It shall also incorporate a flashing strobe light. It shall have a dB level of 86 – 90 at 3 metres.

The bell shall be constructed of high quality materials to ensure reliability and long life and have a baked red enamel finish. The device shall be F.M or LPCB Approved.

1.6.6 Manual Pull Stations (Fire man's switch)

The Manual Pull Station shall be provided for the release (electrical) of the FM 200 in case of an emergency. The unit shall be contained within a metal body having a (single) (double) pole switch. The device shall be F.M or LPCB Approved.

1.6.7 Abort Switch

The abort switch shall be used where an investigation delay is desired between detection and actuation of the FM 200 System.

The Abort Station shall be the "Dead Man" type and shall be located next to each manual.

Switch. "Locking" or "Keyed" abort stations **shall not** be permitted. The Abort Station shall indicate a trouble condition at the Control Panel, if depressed, and no alarm condition exists. The Abort Station shall be located adjacent to each manual station and can be furnished in combination with a Manual Release Switch.

The device shall be U.L listed or F.M Approved for a delay switch.

1.6.8 Pressure Switch

This pneumatically actuated switch shall be used to give positive identification of release of FM 200 in the piping system.

The switch shall have one set of normally open and one set of normally closed contacts.

1.7 SYSTEM INSPECTION AND TESTING

The completed installation shall be inspected by authorized personnel and shall include a full operational test of all components per the equipments manufacturer recommendation including agent discharge.

This shall be done in the presence of the owner's representative and other insuring authority having jurisdiction.

All mechanical and electrical components shall be tested according to the manufacturer's recommended procedure to verify system integrity. The inspection and testing shall be carried out by the contractor. The tests shall demonstrate that the entire control system functions as designed and intended. All circuits shall be tested: automatic actuation, solenoid and manual actuation, HVAC and power shutdowns, audible and visual alarm devices and manual override of abort functions. Supervision of all panel circuits, including AC power and battery power supplies, shall be tested and qualified. Inspection shall include a complete checkout of and certification of weight and cylinder pressure. A written report shall be filed with the Engineer.

Two copies of drawings shall be provided by Contractor indicating the installed details. All routing or piping and electrical conduit and accessories shall be noted. Equipment, Installation and Maintenance Manuals shall be provided in FOUR copies, in addition to the as-built drawings.

Prior to final acceptance, the contractor shall provide operational training in all concepts of this system to the owner's key personnel. Training shall consist of:-

- i) System Control Unit Operation
- ii) Troubleshooting Procedures
- iii) Abort Procedures
- iv) Emergency Procedures
- v) Safety Requirements
- vi) A functional test shall be completed prior to the concentration test consisting of detection, release alarm, accessories related to system, control unit, and a review of the tanks, piping, fittings, hangers and cylinder pressure.

1.8 WARRANTY

All system components shall be guaranteed against defects in design, materials and workmanship for the full warranty period which shall in no case be less than one (1) year from the date of system acceptance.

FIRE PROTECTION					
Item	Description	Qty	Unit	Rate (KShs.)	Amount (KShs.)
	HOSEREEL AND PORTABLE EXTINGUISHERS Supply, deliver and install the following fire fighting equipment in positions indicated on the contract drawings or as shall be instructed by the Engineer.				
	Hose Reel Swinging type hosereel fitted with 30 metres long, 20mm diameter reinforced non-kink rubber hose with 5/6 mm lever operated shut-off nozzle, mild steel feed pipe, isolation valve, guide and all other accessories as 'Angus Fire Armour' or equal and approved.	No.	1		
A					
	GMS Pipes Class B				
B	25mm diameter pipework	Lm	20		
C	50mm diameter pipework	Lm	30		
	Extra Over Pipework				
	Bends				
D	25mm diameter bends	No.	5		
E	50mm diameter bends	No.	5		
	Tees				
F	50mm diameter equal Tee	No.	4		
	Reducers				
G	50 x 25 mm diameter reducer	No.	2		
	Valves				
H	25mm diameter approved medium pressure screw down full way non-rising stem wedge gate valve to BS 1952, with wheel and head joints to steel tubing. The gate valve to be as PEGLER or approved equivalent.	No.	2		
I	50mm diameter gate valves	No.	2		
	Unions				
J	25mm diameter pipe union	No.	2		
K	50mm diameter pipe union	No.	2		
	Total Carried to Summary Page				

Item	Description	Qty	Unit	Rate (Kshs)	Amount (Kshs)
A	Portable Fire Extinguishers Supply, deliver, install, test and commission the following portable fire extinguishers and conforming to BS EN 3 / BS 1449.				
B	Carbon Dioxide Gas Fire Extinguisher 5 Kg carbon dioxide gas portable fire extinguisher complete with pressure gauge, initial charge and mounting brackets.	No.	3		
C	Dry Chemical Powder Fire Extinguisher 6kg dry chemical powder portable fire extinguisher complete with pressure gauge, initial charge and mounting brackets.	No.	3		
D	Fire Blanket Fire blanket made of cloth woven with pre-asbestos yarn or any other fire proof material and to measure 1800 x 1210 mm. It shall be fitted with special tapes folded so as to offer instantaneous single action to release blanket from storing jacket to BS 1721.	No.	1		
E	Fire Notices Allow for fire signage for fire systems, fire exits and fire instructions as directed by the Project Engineer.	2	No		
F	Testing and commissioning	1	Item		
Total Carried forward to page collection page					

<u>COLLECTION PAGE FOR HOSEREEL AND PORTABLES</u>		
Item	Description	Amount (Kshs)
1	Total carried forward from page F-17	
2	Total carried forward from page F-18	
Total for Sprinkler system Carried Forward to Summary Page		

Item	Description	Qty	Unit	Rate (Kshs)	Amount (Kshs)
	FIRE SUPPRESSION SYSTEM (DATA CENTRE)				
	Supply and install fire suppression system with the following items to the satisfaction of the Engineer. The server room and data centre volume are 18m ³ and 30m ³ respectively. The tenderer to submit the technical brochures and working calculations together with the tender for evaluation. Alternative and approved systems utilising inert gases or a mixture of such gases may be provided.				
A	80litre (32.1Kg) normal charged capacity Argonite specified containers charged with Argonite gas at 300bar with dimensions 267mm diameter and 1910mm high when fitted with valve cylinders to be complete with discharge valves gauges and hoses for connection to the manifold. All to be as "Fike" or approved equivalent.	2	No.		
B	80litre (32.1Kg) normal charged capacity Argonite specified containers charged with Argonite gas at 300bar for testing.	1	No		
C	Cylinder support bracket system	1	Item		
D	50mm schedule 40 discharge manifold kit with 2 No. ports complete with end caps and a threaded port for pressure switch. All to be as "Fike" or approved equivalent.	1	Item		
E	25mm selector switch	1	No		
F	Actuation package	1	Item		
G	Solenoid valve/ manual release valve assembly inclusive of hoses, connectors etc.	1	Item		
H	50mm pressure reducing valve	1	No.		
I	15mm Argonite discharge Nozzles V type 6 orifice, Nozzle coverage 360 degrees pattern and a radius of 3M. The Nozzle will be located less than 300mm below the ceiling as "Fike" or approved equivalent.	5	No.		
J	Relief valve	1	No		
K	Check valve	2	No		
L	Pressure gauge	2	No		
M	Pressure relief/vent	2	No		
N	Discharge pressure switch	1	No.		
O	Flexible discharge horse	2	No.		
P	Controls, addressable Control panel and wiring complete with standby batteries	1	Item		
Q	Maintenance switch	1	No.		
	Total Carried to Summary Page				

Item	Description	Qty	Unit	Rate (Kshs)	Amount (Kshs)
A	Double Action manual /electric releasing switch	1	No.		
B	Abort switch	1	No.		
C	Ionization sensors	4	No.		
D	Photo electric sensors	4	No.		
E	Audible alarms	2	No.		
F	Visual alarm	2	No.		
	Pipework				
G	25mm diameter seamless black pipe Schedule 40	100	LM		
H	20mm diameter seamless black pipe Schedule 40	10	LM		
I	15mm diameter seamless black pipe Schedule 40	30	LM		
J	20mm diameter pipe bend/elbow	2	No		
K	15mm diameter pipe bend/elbow	4	No		
L	25mmX20mm pipe reducer	2	No		
M	25mmX15mm pipe reducer	2	No		
N	20mmX15mm pipe reducer	2	No		
O	25mm equal tee	2	No		
P	20mm equal tee	1	No		
Q	Allow for associated Builders work	1	Item		
R	Allow for pipework anchorage/hangers	1	Item		
S	Allow for painting system pipework	1	Item		
T	Electrical works and earthing	1	Item		
U	Labelling and warning signs inside and outside the rooms	2	No		
V	Calculations,working drawings and as installed drawings	1	Item		
	Liquid leakage detection system				
W	Provide an electronic leakage detection system capable of rapid and reliable detection of small quantities of liquid on the floor and walls. The sytem shall be wall mounted with a metal enclosure and inbuilt keyboard. To be complete with point sensors, sensor cable, optical and accoustic alarm signal and should be capable of intergration with the building management system. The system to be as <i>Bartec</i> Model <i>RDW O3</i> or approved equivalent.	1	Item		
	Total Carried to Summary Page				

<u>COLLECTION PAGE FOR FIRE SUPPRESSION SYSTEM</u>		
Item	Description	Amount (Kshs)
1	Total carried forward from page F-20	
2	Total carried forward from page F-21	
Total for Gas fire suppression system Carried Forward to Summary Page		

<u>COLLECTION PAGE FOR PFIRE PROTECTION</u>		
Item	Description	Amount (Kshs)
1	Total carried forward from page F-19	
2	Total carried forward from page F-22	
Total for Fire Protection Carried Forward to Summary Page		

P&D SUMMARY PAGE

Item	Description		Total Cost (Kshs)
1	Total for Sub-contract Preliminaries and General Items	
2	Total carried forward from Collection Page for Plumbing and drainage	
3	Total carried forward from Main Collection Page for Fire Protection	
4	Contingency Sum to be used at the discretion of the Engineer.	500,000.00
Total Cost for Plumbing and Drainage Carried Forward to Grand Summary in Vol. 1 of 5			