# LEBANESE REPUBLIC
# GENERAL DIRECTORATE OF THE PRESIDENCY
# PRESIDENTIAL PALACE COMPOUND- BAABDA

## REHABILITATION OF MAIN ELECTRICAL ROOM/ NEW GENERATORS ROOM IN PRESIDENTIAL PALACE

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# TENDER DOCUMENTS

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# VOLUME 2

# TECHNICAL SPECIFICATIONS

# MECHANICAL ENGINEERING SERVICES - R1

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SPECTRUM ENGINEERING CONSULTANTS S.A.R.L.
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# REHABILITATION OF MAIN ELECTRICAL ROOM/ NEW GENERATORS ROOM IN RESIDENTIAL PALACE

## VOLUME 2 : TECHNICAL SPECIFICATION

## PART 2 – MECHANICAL ENGINEERING SERVICES

### TABLE OF CONTENTS


### *Division 21 – Fire Suppression*

| Section | Section Title |
|---|---|
| 211317 | Fire Extinguishers |
| 212200 | Clean-Agent and FM200 Fire Suppression |

### *Division 22 – Plumbing*

| Section | Section Title |
|---|---|
| 220000 | Plumbing Facilities |
| 220513 | Common Motor Requirements for Plumbing Equipment |
| 220519 | Meters and Gauges for Plumbing Piping |
| 220523 | General Duty Valves for Plumbing Piping |
| 220529 | Hangers and Supports for Plumbing Piping |
| 220553 | Identification for Plumbing Piping & Equipment |
| 220719 | Plumbing Piping Insulation |
| 221116 | Domestic Water Piping |
| 221316 | Facility Sanitary Sewerage |
| 221319 | Sanitary Waste Piping Specialties |
| 223300 | Electrical Water Heater |
| 224100 | Plumbing Fixtures |

### *Division 23 – Fuel Oil System*

| Section | Section Title |
|---|---|
| 231113 | Fuel Oil System |
| 233113 | Metal Ducts |
| 233313 | Motorized Fire Dampers |
| 233416 | HVAC Fans |
| 233713 | Air Outlets |
| 235123 | Generator Engine Exhaust System |
| 238126 | DX Split A/C System |

# SECTION 211317
# FIRE EXTINGUISHERS

# SECTION 211317
# FIRE EXTINGUISHERS

## Part 1 - GENERAL

### 1.01 SUMMARY

A. Section includes portable, hand-carried fire extinguishers.

### 1.02 SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher.

B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function.

C. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

### 1.03 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10,"Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

### 1.04 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

### 1.05 WARRANTY, RESPONSIBILITIES, MAINTENANCE AND ACCEPTANCE

A. Refer to Annex A, showing schedule of equipment warranties, maintenance obligations and financial security.

## Part 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Basis of Design Manufacturer: To establish a standard of quality, design and function desired, drawings and specifications are based on products by the approved manufacturer.

B. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following manufacturers:
   1. Naffco
   2. SFFECO
   3. ANSUL
   4. MOBIAK S.A.
   Or approved equal

### 2.02 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. PFE-6KG Dry Chemical Portable Fire Extinguisher

6 kg store-pressure ABC dry chemical portable fire extinguisher, suitable for Class A,B and C fires, complete with steel cylinder, pressure gauge, discharge hose, wall mounting bracket, safety pin, and tamper seal. UL/FM listed and manufactured in accordance with NFPA 10.

B. PFE-5KG $CO_2$ Portable Fire Extinguisher

5kg carbon dioxide ($CO_2$) portable fire extinguisher, suitable for Class B and electrically energized (Class C) fires, complete with seamless steel cylinder, discharge horn, wall mounting bracket, safety pin, and tamper seal. UL/FM listed and manufactured in accordance with NFPA 10.

C. PFE-6L Foam Portable Fire Extinguisher

6L stored-pressure foam portable fire extinguisher, suitable for Class A and B fires, complete with steel cylinder, pressure gauge, discharge hose/nozzle, wall mounting bracket, safety pin, and tamper seal. UL/FM listed and manufactured in accordance with NFPA 10.

### 2.03 ACCESSORIES

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

## Part 3 - EXECUTION

### 3.01 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

# SECTION 212200
# CLEAN-AGENT AND FM200 FIRE SUPPRESSION

# SECTION 212200
# CLEAN-AGENT AND FM200 FIRE SUPPRESSION

## Part 1 - GENERAL

### 1.01 RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 21 Specification Sections, apply to this Section.

### 1.02 SUMMARY

A. Section Includes:

1. Piping and piping specialties.
2. Extinguishing-agent containers.
3. Extinguishing agent.
4. Detection and alarm devices.
5. Control and alarm panels.
6. Accessories.
7. Connection devices for and wiring between system components.
8. Connection devices for power and integration into building's fire-alarm system.

### 1.03 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. EPO: Emergency Power Off.

### 1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:
1. Product Data for Credit EA 4: Documentation indicating that clean agents comply.

C. Shop Drawings: For FM200 clean-agent fire-extinguishing system signed and sealed by a qualified professional engineer.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include design calculations.
3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

4. Wiring Diagrams: For power, signal, and control wiring.
   Delegated-Design Submittal: For clean-agent fire-extinguishing system signed and sealed by the qualified professional engineer.
5. Indicate compliance with performance requirements and design criteria, including analysis data.
6. Include design calculations for weight, volume, and concentration of extinguishing agent required for each hazard area.
7. Indicate the Following on Reflected Ceiling Plans:
   a. Ceiling penetrations and ceiling-mounted items.
   b. Extinguishing-agent containers if mounted above floor, piping and discharge nozzles, detectors, and accessories.
   c. Method of attaching hangers to building structure.
   d. Other ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
8. Indicate the Following on Occupied Work Area Plans:
   a. Controls and alarms.
   b. Extinguishing-agent containers, piping and discharge nozzles if mounted in space, detectors, and accessories.
   c. Equipment and furnishings.
9. Indicate the Following on Access Floor Space Plans:
   a. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.
   b. Method of supporting piping.
10. Indicate the Following on Ceiling Plans:
    a. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.
    b. Method of supporting piping.
    c. Other equipment located in the ceiling space that is being protected including sprinkler piping, HVAC equipment, raceways, or conduit.

D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
   1. Domestic water piping.
   2. Items Penetrating Finished Ceiling Include the Following:
      a. Lighting fixtures.
      b. Air outlets and inlets.

E. Permit Approved Drawings: Working plans, prepared according to NFPA 2001, that have been approved by authorities having jurisdiction. Include design calculations.

F. Field quality-control reports.

G. Operation and Maintenance Data: For special agent system to include in emergency, operation, and maintenance manuals.

## 1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. FM Global Compliance: Provide components that are FM Approved and that are listed in FM Global's "Approval Guide."

C. UL Compliance: Provide equipment listed in UL's "Fire Protection Equipment Directory."

D. Comply to latest Civil Defense Department regulations.

## 1.06 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.
   1. Detection Devices: Not less than 20 percent of amount of each type installed.
   2. Container Valves: Not less than 10 percent of amount of each size and type installed.
   3. Nozzles: Not less than 20 percent of amount of each type installed.
   4. Extinguishing Agent: Not less than 100 percent of amount installed in largest hazard area. Include pressure-rated containers with valves.

## 1.07 WARRANTY, RESPONSIBILITIES, MAINTENANCE AND ACCEPTANCE

A. Refer to Annex A, showing schedule of equipment warranties, maintenance obligations and financial security.

## Part 2 - PRODUCTS

### 2.01 CLEAN-AGENT SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
   1. Ansul Incorporated.
   2. Chemetron Fire Systems.
   3. Fike Corporation.
   4. Pyro-Chem.
   5. Tyco Safety Products Group.
   6. LPG Group of Companies.
   Or approved equal

C. Description: Clean-agent fire-extinguishing system FM200 shall be an engineered system for total flooding of the hazard area including the room cavity above the ceiling, below the ceiling, and below the raised floor. System includes separate zones above and below the ceiling and beneath the raised floor. If smoke is detected below the raised floor, extinguishing agent shall be discharged in the under floor zone only. If smoke is detected below the ceiling, extinguishing agent shall be discharged in zones above and below the ceiling and below the floor. If smoke is detected above the ceiling, extinguishing agent shall be discharged in the zone above the ceiling only.

D. Delegated Design: Design clean-agent fire-extinguishing system and obtain approval from authorities having jurisdiction. Design system for Class A, B, and C fires as appropriate for areas being protected, and include safety factor. Use clean agent indicated and in concentration suitable for normally occupied areas.

E. Performance Requirements: Discharge HFC 227ea within 10 seconds and maintain 7.1 percent concentration by volume at 70 deg F (21 deg C) for 10-minute holding time in hazard areas.
   1. HFC 227ea concentration in hazard areas greater than 9.0 percent immediately after discharge or less than 6.5 percent throughout holding time will not be accepted without written authorization from Client and authorities having jurisdiction.

F. Performance Requirements: Discharge IG-541 within 60 seconds and maintain 38 percent concentration by volume at 70 deg F (21 deg C) for 10-minute holding time in hazard areas.

G. Cross-Zoned Detection: Devices located in two separate zones. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating single-detection device in other zone.

H. Verified Detection: Devices located in single zone. Sound alarm on activating single detection device, and discharge extinguishing agent on actuating second-detection device.

I. System Operating Sequence:
   1. Actuating First Detector: Visual indication on annunciator panel. Energize audible and visual alarms (slow pulse), shut down air-conditioning and ventilating systems serving protected area, close doors in protected area, and send signal to fire-alarm system.
   2. Actuating Second Detector: Visual indication on annunciator panel. Energize audible and visual alarms (fast pulse), shut down power to protected equipment, start time delay for extinguishing-agent discharge for 30 seconds, and discharge extinguishing agent.

   3. Extinguishing-agent discharge will operate audible alarms and strobe lights inside and outside the protected area.

J. Manual stations shall immediately discharge extinguishing agent when activated.

K. Operating abort switches will delay extinguishing-agent discharge while being activated, and switches must be reset to prevent agent discharge. Release of hand pressure on the switch will cause agent discharge if the time delay has expired.

L. EPO: Will terminate power to protected equipment immediately on actuation.

M. Low-Agent Pressure Switch: Initiate trouble alarm if sensing less than set pressure.

N. Power Transfer Switch: Transfer from normal to stand-by power source.

## 2.02 FM200 AUTOMATIC FIRE PROTECTION SYSTEM:

A. General: Supply and install FM200 automatic fire protection system wherever shown on drawings and as specified herein.

Provide fixed total flooding FM200 fire extinguishing system and Companion fire detection system for protection of rooms as shown on drawings.

Each system to include main and reserve banks of FM200 cylinders feeding common manifold from which piping of suitable size is to run to discharge nozzles. Transfer from main to reserve bank is to be by an electric switch.

Detectors be cross-zoned in each protected space and lead back to status panel. Each system to be two-zone controlled. Actuation of any detector is to indicate a first stage alarm condition on status panel and intermittently operate audio-visual alarm unit. Actuation of any two detectors, one per zone, is to indicate a fire condition in both zones of status panel, give continuous audio-visual alarm and after a preset discharge delay, energize FM200 operating switch-leg up to discharge delay. Detection system is to include voltage-free contacts for shut down of mechanical equipment during count-down of discharge delay.

Discharge of FM200 may be aborted during discharge delay period by holding in a lock-off switch located in status panel. Time delay device to be adjustable from 5 to 60 seconds.

System not aborted: After delay period, solenoid type control heads on main cylinders are to operate and release FM200. At the same time, pressure operated switch and pressure operated trips are to control closing of doors and ventilation shutters to prevent loss of FM200 after being discharged.

Pressure operated trips: To be fed from discharge nozzle tees by 15mm diameter line.

Pressure operated switch: To be fed from the discharge header by 15mm diameter line.

Auxiliary manual discharge operation is to be provided through remote electric switch case or through manually operated non-electric levers on cylinder control heads. Either means to be arranged to by-pass discharge delay and abort circuitry.

Entire storage and distribution system is to completely discharge FM200 into hazard space within 10 seconds after FM200 appears at discharge nozzles.

Design system in accordance with BS or NFPA and totally flood the hazard areas. Concentration to be as per requirements for deep-seated fires.

Materials and equipment to be first grade, standard current products of manufacturer, suitable for performance of their separate functions and to

conform to Underwriter's Laboratories Inc., of Factory Mutual System requirements, or UK equivalent.

Cylinder assemblies to be filled in accordance with the requirements of BS or NFPA.

Flow calculations are to provided to prove integrity of pipe and nozzle sizes. Calculations are to include dimensions and volume of room, design temperature, FM200 volume factor, required quantity, size and fill weight of cylinders, volumetric concentration, discharge time, flow rate per nozzle, type of nozzle, pipe sizes, nozzle thread and orifice sizes. Allowance for non-closable.
Pipes: Galvanized steel, seamless.
Fittings: Galvanized, 20 bars (300 psi), malleable iron pressure type.
Manifold: Fabricate from standard weight galvanized steel pipe and galvanized fittings.

Piping joints: To the requirements of BS or NFPA.
Bushings: Hex steel and limited to reductions of not more than two pipe sizes.
Extinguishing agent: FM200 (HFC 227 ea)

B. Storage Cylinders: Shall be floor standing type, constructed of high strength steel alloy conforming to all applicable specifications of the U.S. Department of Transportation. Containers – Hazardous Materials or equal approved authority. Mount in an upright position and hold securely in steel racks with clamps or straps. Each cylinder to have a discharge valve. Connect cylinders to manifold with non-metallic tubing through check valve to prevent FM200 loss during discharge.

C. Reserve cylinders: shall be filled identically to main cylinders, of equal quantity and continued on same rack. Reserve bank to duplicate all functions of main bank.

D. Racks: shall be type allowing any cylinder to be weighed without removing it from framework and without putting system out service. Racks to be complete with clamps, weigh bars and all other items necessary to provide a complete installation. Provide scales and scale beams (ratio 10 to 1).

E. Cylinder discharge valve: shall operate by differential force using cylinder pressure as source. Force differential and metallic spring are to hold valve closed prior to discharge and to reverse upon actuation to open the valve. Reversal is to be by venting agent through an opening on cylinder valve. Discharge to be not less than 90-95% by weight of FM200.

F. Discharge nozzles: shall be multi-jet type of corrosion resistant brass construction, finished with protective coating and with female threaded connection, complete with blow-off cover. Nozzle to be threaded directly to piping without use of special adaptors.

G. Detection system: each to be fully supervised type in which any trouble within system causes common trouble buzzer to sound and trouble lamp to light on control panel. Silence switch is to be provided to silence trouble buzzer. Trouble zone lamps are to remain lit until trouble is cleared. Each zone to

have its own trouble lamp. Ring back feature is to sound trouble buzzer after trouble is cleared if silence switch is in silence position. Common alarm buzzer and alarm silence switches are to be provided for each zone.

H. Hazard alarm: shall be included in detection system and having outstanding sound level and distinctive tone to warn of hazardous condition and possible FM200 discharge.

## 2.03 PIPING MATERIALS

A. Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA 2001, Section "Distribution," for charging pressure of system.

## 2.04 PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, Grade B or ASTM A 106/A 106M, Grade A; Schedule 40,Schedule 80, and Schedule 160, seamless steel pipe.
   1. Threaded Fittings:
      a. Malleable-Iron Fittings: ASME B16.3, Class 300.
      b. Flanges and Flanged Fittings: ASME B16.5, Class 300 unless Class 600 is indicated.
      c. Fittings Working Pressure: 620 psig (4278 kPa) minimum.
      d. Flanged Joints: Class 300 minimum.
   2. Forged-Steel Welding Fittings: ASME B16.11, Class 3000, socket pattern.
   3. Steel, Grooved-End Fittings: FM Approved and NRTL listed, ASTM A 47/A 47M malleable iron or ASTM A 536 ductile iron, with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Steel, Keyed Couplings: UL 213, approved or listed for clean-agent service, and matching steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gasket, and steel bolts and nuts.

## 2.05 VALVES

A. General Valve Requirements:
   1. UL listed or FM Approved for use in fire-protection systems.
   2. Compatible with type of clean agent used.

B. Container Valves: With rupture disc or solenoid and manual-release lever, capable of immediate and total agent discharge and suitable for intended flow capacity.

C. Valves in Sections of Closed Piping and Manifolds: Fabricate to prevent entrapment of liquid, or install valve and separate pressure relief device.

D. Valves in Manifolds: Check valve; installed to prevent loss of extinguishing agent when container is removed from manifold.

## 2.06 DISCHARGE NOZZLES

A. Equipment manufacturer's standard one-piece brass or aluminum alloy of type, size, discharge pattern, and capacity required for application.

## 2.07 MANIFOLD AND ORIFICE UNIONS

A. Description: NRTL-listed device with minimum 2175-psig (15-MPa) pressure rating.

1. NPS 2 (DN 50) and Smaller: Piping assembly with orifice, sized for system design requirements.
2. NPS 2-1/2 (DN 65) and Larger: Piping assembly with nipple, sized for system design requirements.

## 2.08 CONTROL PANELS

A. Description: FM Approved or NRTL listed, including equipment and features required for testing, supervising, and operating fire-extinguishing system.

B. Power Requirements: 240-V ac; with electrical contacts for connection to system components and fire-alarm system, and transformer or rectifier as needed to produce power at voltage required for accessories and alarm devices.

C. Enclosure: NEMA ICS 6, Type 1, enameled-steel cabinet.
1. Mounting: Recessed flush with surface.

D. Supervised Circuits: Separate circuits for each independent hazard area.

1. Detection circuits equal to the required number of zones, or addressable devices assigned to the required number of zones.
2. Manual pull-station circuit.
3. Alarm circuit.
4. Release circuit.
5. Abort circuit.
6. EPO circuit.

E. Control-Panel Features:
1. Electrical contacts for shutting down fans, activating dampers, and operating system electrical devices.
2. Automatic switchover to standby power at loss of primary power.
3. Storage container, low-pressure indicator.
4. Service disconnect to interrupt system operation for maintenance with visual status indication on the annunciator panel.

F. Standby Power: Sealed lead calcium batteries with capacity to operate system for 24 hours and alarm for minimum of 15 minutes. Include automatic battery charger that has a varying charging rate between trickle and high depending on battery voltage, and that is capable of maintaining batteries fully charged. Include manual voltage control, dc voltmeter, dc ammeter, electrical contacts for connection to control panel, automatic transfer switch, and suitable enclosure.

## 2.09 DETECTION DEVICES

A. General Requirements for Detection Devices:
   1. Comply with NFPA 2001, NFPA 72, and UL 268.
   2. 24-V dc, nominal.

B. Ionization Detectors: Dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.

C. Photoelectric Detectors: LED light source and silicon photodiode receiving element.

D. Remote Air-Sampling Detector System: Includes air-sampling pipe network, a laser-based photoelectric detector, a sample transport fan, and a control unit.

E. Signals to the Central Fire Alarm Control Panel: Any type of local system trouble is reported to the central fire alarm control panel as a composite "trouble" signal. Alarms on each system zone are individually reported to the central fire alarm control panel as separately identified zones.

## 2.10 MANUAL STATIONS

A. General Description: Surface FM Approved or NRTL listed, with clear plastic hinged cover, 240-V ac or low voltage compatible with controls. Include contacts for connection to control panel.

B. Manual Release: "MANUAL RELEASE" caption, and red finish. Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked.
   1. Abort Switch: "ABORT" caption, momentary contact, with green finish.
   2. EPO Switch: "EPO" caption, with yellow finish.

## 2.11SWITCHES

A. Description: FM Approved or NRTL listed, where available, 240-V ac or low voltage compatible with controls. Include contacts for connection to control panel.
   1. Low-Agent Pressure Switches: Pneumatic operation.
   2. Power Transfer Switches: Key-operation selector, for transfer of release circuit signal from main supply to reserve supply.
   3. Door Closers: Magnetic retaining and release device or electrical interlock to cause the door operator to drive the door closed.

## 2.12ALARM DEVICES

A. Description: Listed and labeled by an NRTL or FM Approved, low voltage, and surface mounting. Comply with requirements in Division 28 Section "Digital, Addressable Fire-Alarm System" or Division 28 Section "Zoned (DC Loop) Fire-Alarm System" for alarm and monitoring devices.

B. Bells: Minimum 6-inch (150-mm) diameter.

C. Horns: 90 to 94 dBA.

D. Strobe Lights: Translucent lens, with "FIRE" or similar caption.

## 2.13ELECTRICAL POWER AND WIRING

A. Electrical power, wiring, and devices are specified in other Division.

## Part 3 - EXECUTION

### 3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with hazard-area leakage requirements, installation tolerances, and other conditions affecting work performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 HFC 227EA AGENT PIPING APPLICATIONS

A. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.

B. NPS 2 (DN 50) and Smaller: Schedule 40, steel pipe; malleable-iron threaded fittings; and threaded joints.

C. NPS 2-1/2 (DN 65) and Larger: Schedule 40, steel pipe; forged-steel welding fittings; and welded joints.

### 3.03 CLEAN-AGENT PIPING INSTALLATION

A. Install clean-agent extinguishing piping and other components level and plumb, according to manufacturers' written instructions.

B. Grooved Piping Joints: Groove pipe ends according to AWWA C606 dimensions. Assemble grooved-end steel pipe and steel, grooved-end fittings with steel, keyed couplings and lubricant according to manufacturer's written instructions.

C. Install extinguishing-agent containers anchored to substrate.

D. Install pipe and fittings, valves, and discharge nozzles according to requirements listed in NFPA 2001, Section "Distribution."
   1. Install valves designed to prevent entrapment of liquid, or install pressure relief devices in valved sections of piping systems.
   2. Support piping using supports and methods according to NFPA 13.
   3. Install seismic restraints for extinguishing-agent containers and piping systems.
   4. Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA 2001, Section "Detection, Actuation, and Control Systems," as required for supervised system application.

### 3.04 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

C. Connect electrical devices to control panel and to building's fire-alarm system. Electrical power, wiring, and devices are specified in other Division.

### 3.05 IDENTIFICATION

A. Identify system components and equipment. Comply with requirements for identification specified in other Division 26 Section for Electrical Systems.

B. Identify piping, extinguishing-agent containers, other equipment, and panels according to NFPA 2001.

C. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected with a clean-agent fire-extinguishing system.

D. Install signs at entry doors to advise persons outside the room the meaning of the horn(s), bell(s), and strobe light(s) outside the protected space in two different languages.

### 3.06 FIELD QUALITY CONTROL

A. Testing Agency: [Owner will engage] [Engage] a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:
   1. After installing clean-agent extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.
   2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.
   3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
   5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Arrange Civil Defense Department visit to site test, demonstrate the system for their approval.

F. Units will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

## 3.07 CLEANING

A. Each pipe section shall be cleaned internally after preparation and before assembly by means of swabbing, using a suitable nonflammable cleaner. Pipe network shall be free of particulate matter and oil residue before installing nozzles or discharge devices.

## 3.08 SYSTEM FILLING

A. Preparation:
   1. Verify that piping system installation is completed and cleaned.
   2. Check for complete enclosure integrity.
   3. Check operation of ventilation and exhaust systems.
B. Filling Procedures:
   1. Fill extinguishing-agent containers with extinguishing agent, and pressurize to indicated charging pressure.
   2. Install filled extinguishing-agent containers.
   3. Energize circuits.
   4. Adjust operating controls.

## 3.09DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain clean-agent fire extinguishing systems.

# SECTION 220000
# PLUMBING FACILITIES

# SECTION 220000
# PLUMBING FACILITIES

## Part 1 - GENERAL

### 1.01 SUMMARY

A. Section Includes: Complete Plumbing System in accordance with the requirements of the Contract Documents, work includes:
   1. Service connections to external utilities.
   2. Domestic cold water supply system.
   3. Domestic hot water supply system.
   4. Soil, waste and vent system.
   5. Storm water drainage system.
   6. Sanitary fixtures.
   7. Plumbing equipment.
   8. Plumbing specialties
   9. General duty valves.

### 1.02 SYSTEM DESCRIPTION

A. System Performance:
   1. The Contractor shall guarantee that all elements of the system are of sufficient capacity to meet the performance requirements stipulated in or implied by the Contract Documents.

B. Design Requirements:
   1. All the system components shall be of the type and construction, capable of withstanding the water and ambient conditions and shall be resistant to deterioration from high incidence of ultra violet rays.

   2. Electrical Enclosures: All electrical enclosures such as control panels, pump motors, etc., shall be rated at IP54 unless otherwise stated. Each and every control panel shall have its own disconnect switch or be provided with a local isolator adjacent to the panel so as to isolate the power supply during maintenance. All knockouts for the cable entries shall be at the bottom of the panels.
   3. General Stipulations:
      a. The Contractor shall allow in his Tender for making all connections to existing services and shall submit details and drawings of each connection to the Engineer for his prior approval.
      b. The Contract Drawings show the various piping systems schematically. Tenderers shall satisfy themselves that the layouts shown accurately represent the existing conditions and no added compensation will be permitted for any work due to want of Knowledge in this respect.
      c. Furnish all sleeves for passage of pipes through structural masonry and concrete walls and floors and elsewhere as will be required for the proper protection of each pipe.
      d. Check the existence of any service, surface or sub-surface structure in the vicinity of the work. Do not disturb or damage any of these services or structures and make necessary provisions by shoring or other means

in order to avoid damaging these services or structures. Repair any damage immediately.

e. Carefully examine the structural, HVAC and electrical drawings to avert possible installation conflicts.
f. Submit to the Engineer shop drawings covering all items of work under this Contract. No work shall be carried out until the shop drawings have been approved by the Engineer Reproduction of Contract Drawings by the Contractor shall not be acceptable as shop drawings.

## 1.03 SUBMITTALS

A. General: All submissions for approval shall be submitted sufficiently in advance of requirements to allow the Engineer ample time for checking and approving. These clauses are in addition to the contract requirements.

B. Samples: Submit samples, as requested by the Engineer of all materials and equipment specified herein in accordance with the requirements of the Contract Documents and before ordering obtain written approval from the Engineer. All samples shall be properly tagged when submitted for approval.

C. Product Data:
1. Manufacturer's Data: Prior to the submission of shop drawings, submit to the Engineer full details, specifications, installation instructions, tc., of all materials and equipment proposed for use but in all cases no such materials/equipment shall be ordered, delivered or installed without the prior written approval of the Engineer to the Contractor's shop drawings incorporating the said materials/equipment. Any material or equipment which is not approved but installed shall be removed and replaced at the Contractor's expense.
2. The details of materials and equipment shall include the following:
    a. Full technical specifications of equipment including construction, materials, degree of protection, characteristic curves, test and performance certificates of equipment, diagrams, capacities, rating, dimensions, fixing details, etc.
    b. Relevant sheets of manufacturers' catalogues, specifications, technical data, etc.
    c. The estimated current consumption and heat dissipation of any equipment proposed.
    d. Maintenance and supervisory statistics as approved by others for similar systems.
3. At the time of providing the above details submit a statement from manufacturer to the effect that the proposed materials, equipment and systems' performance and functions comply fully with the relevant Clauses of the Specification and, in case of deviation from the Specification, submit a schedule of deviations listing all points not conforming to the Specification.
4. At the same time submit a preliminary time schedule to indicate all logistical elements (i.e. design, submission for approved, ordering, shipping, delivery, installation, etc.).

D. Shop Drawings:
1. General external piping layout drawings to a scale not smaller than 1:100.

2. Equipment installation and piping layout, double line drawings off toilets, bathrooms, kitchens, plant rooms, sump pumps, etc. Clearly indicating all fittings, supports, valves etc. to a scale of 1:20. Submit sections and wall elevations as appropriate.
3. Typical floor plans indicating shafts, risers locations etc. to a scale of 1:50.
4. Builder's work layout plans to a scale of 1:100/1:50 as above along with shaft detail plans to 1:10.
5. Assemblies like pressure reducing valves and items of similar nature to a scale of 1:10.
6. Vacuum breakers, hydrants, air release valves, sleeves and penetrations, all types of drains and clean outs, etc. to a scale of 1:5.
7. Equipment like filters and items of similar nature to a scale of 1:20.
8. Electrical wiring diagrams (NTS) and panel installation details (1:20).
9. Calculations / details to substantiate the shop drawings.

E. Progress record Drawings: Submit project record documents of all works installed under this section, in accordance with the following:
   1. Furnish and keep on the job at all times one complete and separate set of black-line prints of the plumbing work on which shall be clearly, neatly and accurately noted, promptly as the work progresses all plumbing changes, revisions and additions to work as actually installed. Wherever work is installed other than as shown on the Contract Drawings, such changes shall be noted.
   2. Indicate daily progress on progress prints by colouring in the various pipes, fixtures, apparatus and associated attachments as they are erected.
   3. No approval for payment of work installed will be given unless supported by coloured-up record prints as required above.

F. "As-built" Drawings:
   1. At the conclusion of work, prepare and submit "as-built" Drawings prepared from the latest progress prints.
   2. Contractor shall prepare as-built drawings and submit and obtain approval for the respective services. Necessary follow-up, calculations shall be submitted by the Contractor as required by these authorities.
   3. In addition, submit sets of CD's of all "as-built" drawings.

G. Operation and Maintenance Instruction Manuals
   1. At the time of submitting "as-built" drawings, provide the Engineer with three properly printed and bound copies of operation and maintenance instruction manuals for each system of Plumbing Work to describe the various systems in the fullest detail to facilitate the proper operation, maintenance, replacement of parts and awareness of system characteristics and complete building systems description.

## 1.04 QUALITY ASSURANCE

A. Specialist Subcontractor for the works shall meet the requirements as specified.

B. Installer Qualifications: The plumbing work shall be executed by an approved Specialist Contractor having minimum 10 years experience in similar type of works.

C. Regulatory Requirements:

1. Ensure that, where applicable, the work and any materials used in the execution of the work in accordance with the Contract, comply with the requirements of the particular Public Authority having jurisdiction.
2. Where necessary to comply with regulations, inform the Public Authority of the proposed work and obtain from them any written approval that may be required.
3. Submit to the Public Authority any materials for testing that the Authority may require. Provide the Engineer with a copy of all correspondence, test certificates, etc., in connection with the works.
4. Comply with the relevant requirements of the National Plumbing Code.

## 1.05 MAINTENANCE

A. Operation and Maintenance:
1. Include for Operation, Routine Maintenance and Preventive Maintenance commencing from testing and commissioning until the end of the Contract Defect's Liability Period of 2 years from the date of Substantial Completion with requirements of Contract Documents as follows:
    a. Defect liability/breakdown maintenance, inclusive of replacement parts.
    b. Preventive maintenance as scheduled, inclusive of replacement parts and consumables.
    c. Operation of all systems.
    d. Attending to emergency situations, which may damage property or endanger lives, even outside normal working hours.
    e. Provide a written report to the Employer, detailing the maintenance work performed; including dates, parts replaced etc.
    f. The Employer's personnel shall be allowed to witness or participate (without damageous interference) in the above activities.
2. Provide all necessary operation and maintenance staff experienced in both mechanical and electrical work such as engineer on-call basis, one foreman, one plumber (experienced in plumbing and electrical works) with helpers, etc., for effective maintenance of all systems. Submit to the Engineer for approval qualification details of all maintenance staff.
3. The Contractor shall note that during the Defect's Liability Period, rapid response to calls for attendance on-site may be necessary. It may, therefore, be necessary, at times, for the Contractor to undertake repairs to defective Contract Works outside normal working hours. Include all routine and preventive scheduled maintenance as recommended by the equipment manufacturers to keep plant and pipework in perfect operating condition.
4. The minimum staff/supervision required for operation and maintenance shall be employed during the Defect's Liability Period.
5. Submit a maintenance schedule for approval by the Engineer.
6. Keep all records, log books, log sheets, maintenance job cards, etc., in neat order to the satisfaction of the Engineer. All records, log books, and log sheets, charts, maintenance job cards, etc., shall become the property of the Employer.
7. During the Defect's Liability Period control, maintain, replace and repair any part of equipment or material within the systems which may prove defective due to Contractor's design, erection, performance, or workmanship, or prove defective from any act or omission that may develop from use in the Works or any section thereof. Defective is hereby defined to include, but not limited to operation or control system failures, Performances below required minimum, excessive wear, unusual deterioration or aging of materials or finishes,

unsafe conditions, the need of excessive maintenance, abnormal noise or vibration and similar unusual, unexpected and unsatisfactory conditions.

8. Provide all spare parts for replacements made necessary due to wear and tear of equipment. Provide all consumable parts, short life parts, oils, etc., and all tools and maintenance equipment required for proper complete maintenance of the Works.
9. Provide all routine operational maintenance and full preventive maintenance as recommended by the equipment manufacturers to keep equipment and systems in proper operating condition.
10. Provide the routine operational maintenance activities and full preventive maintenance procedures relating to the systems.
11. Be responsible for training the Employer's personnel selected by the Engineer in the correct operation, control and maintenance of the installations specified herein. Training shall be carried out by qualified commissioning and operating staff of the Contractor.
12. The foregoing Clauses are in addition to and in no way relieve the Contractor of his liabilities and obligations under the Contract.

B. Tools and Maintenance Equipment

1. In addition to the spare parts, tools and maintenance equipment provided by the Contractor pursuant to his obligations to maintain the systems specified herein throughout the Contract Defect's Liability Period, the Contractor shall, prior to completion of the Construction Works, supply the spare parts, tools and maintenance equipment specified herein for use after the expiry of such Defect's Liability Period, and store the same in a location in the building designated by the Engineer. Such specified spare parts, tools and maintenance equipment shall not be used by the Contractor during the period of maintenance unless in an emergency and as expressly authorized by the Engineer.
2. All spare parts, tools and maintenance equipment shall be provided in original packing, clearly labelled and referenced. Provide complete schedules of spare parts and maintenance equipment clearly cross referenced with the "as-built" record drawings and with operation and maintenance instructions manuals.
3. All spare parts, tools and maintenance equipment shall be as recommended by the equipment manufacturer and shall be subject to the final approval of the Engineer.
4. Supply spare parts and maintenance equipment for all plant and pipework systems including valves, controls, filters, sanitary fixtures and like items requiring maintenance and replacement sufficient for a period of two (2) years after the expiry of the Defect's Liability period, unless otherwise stated.
5. Supply one new complete set of tools for the proper operation, routine maintenance and adjustment of all components and equipment.

C. Spare Parts:

1. Spare Parts, Tools and Maintenance Equipment
    a. In addition to the spare parts, tools and maintenance equipment provided by the Contractor pursuant to his obligations to operate and maintain the systems specified herein throughout the Contract Maintenance Period, the Contractor shall prior to completion of the Works, supply the spare parts, tools and maintenance equipment specified herein in the various Sections of the Plumbing & Fire Protection Specifications for use after the expiry of such Maintenance

Period, and store the same in a location in the building designated by the Engineer. Such specified spare parts, tools and maintenance equipment shall not be used by the Contractor during the period of maintenance unless in an emergency and as expressly authorized by the Engineer.

b. All spare parts, tools and maintenance equipment shall be provided in original packing, clearly labeled and referenced. Provide complete schedules of spare parts and maintenance equipment clearly cross referenced with the "as-built" record drawings and with operation and maintenance instructions manuals.
c. All spare parts, tools and maintenance equipment shall be as recommended by the equipment manufacturer and shall be subject to the final approval of the Engineer.
d. Spares and maintenance equipment shall include but not limited to:
    i) Pumps : shafts, shaft sleeves, stuffing boxes, bearings, couplings, gaskets, glands, bushes, Impeller, Mechanical Seal, Wearing Ring, LED Lamp for control panel, Fuses of control panel, Over load protection relay, etc.
    ii) Valves: complete sets of washers, gaskets, packing glands, discs, seating etc. that can be renewed.
    iii) Sanitary Fixtures: Provide Spare sanitary fixtures of at least 2% of total quantity of types of sanitary fixtures with all required waste and water supply fittings as per specifications.
    iv) Plumbing Specialties: Provide spare plumbing specialties of at least 2% of total quantity or 3 Nos. whichever is more of each type of plumbing specialties.
e. The Contractor shall provide with the tender a separate priced list of spare parts recommended for two years duration after the free maintenance period (Defects Liability Period). This spare parts list will be recommended by the manufacturer for fire protection works and valid for a two year period, but whose total cost does not form part of the tender lump sum.
f. If any defect that arises during the maintenance period is not remedied by the Contractor within a reasonable time, the Engineer may arrange for the work to be done at the Contractors expense.
g. Supply two new complete sets of tools complete with lockable tool boxes for the proper operation, routine maintenance and adjustment of all components and equipment.
h. In a room designated by the Engineer provide suitably robust storage racks, shelves, trays, boxes, cupboards, work benches, etc., to store all normally held stocks of spare parts, consumables and all tools, maintenance equipment and accessories specified herein for all electro-mechanical works. Provide a suitable spare parts (card index) inventory system to record the use of such spares and consumables and to facilitate re-stocking requirements and incorporate as data base for the Maintenance Management Program to be provided under Building Automation System.

D. Operation and Maintenance Instruction Manuals: Submit hard bound copies of “Operation and Maintenance Manual”, as built drawings and with complete data for each piece of equipment installed, as detailed below:
    1. Table of contents.

2. Plumbing material submittal with the Engineer's and local authorities approval.
3. Manufacturer's installation instructions.
4. Manufacturer's internal wiring diagrams.
5. Manufacturer's assembly details.
6. Replacement, parts number listings and description.
7. Preventive maintenance schedules listing frequency of service and or replacement.
8. Lubrication materials, equivalents and schedules.
9. Name and addresses of manufacturer, sales and service agency and local representative / distributor including telephone, telex and telefax nos.
10. Names and addresses of Contractor's maintenance department, including emergency contact telephone numbers.
11. Arrange the contents of the manual in sections with tags, grouping each class of equipment as pumps, fixtures, water heaters, filters, controls, etc.
12. Arrange contents of each section in sequence as listed above (Item 2).

## 1.06 WARRANTY, RESPONSIBILITIES, MAINTENANCE AND ACCEPTANCE

A. Refer to Annex A, showing schedule of equipment warranties, maintenance obligations and financial security.

## Part 2 - PRODUCTS

Refer to individual section for plumbing materials and equipment.

## Part 3 - EXECUTION

### 3.01 PREPARATION

A. Study all drawings and specifications and familiarize with the structural and architectural details and the work of other trades.

B. Ensure that the work under this section will not interfere with those of other trades and are compatible with the architectural finishes, prior to placing orders, fabrication and installation.

C. Coordinate with the electrical works for the exact power requirements and location and type of the interface. Furnish all information as required by the Client for obtaining approvals.

D. Furnish necessary templates, patterns, setting out plans and other items for incorporation in the works or for leaving necessary provisions for the work. Ensure timely placement of sleeves, inserts and the like.

E. Where work is installed in close proximity to or will interfere with other works, assist in working out satisfactory space arrangements. Prepare composite shop drawings to a suitable scale showing how the work is installed in relation to the work of other trades.

F. Ensure the sufficiency of dimensions of the plant areas, doors etc. and the suitability of slabs and other structural members for placement, operation and maintenance of equipment.

G. Resolve conflicts in requirements with other trades. Refer to the Engineer, only those which cannot be solved without changes to structure or those which involves major changes to system design.

### 3.02 INSTALLATION

A. Access Door
   1. Provide access doors in walls and ceilings as required for operation and maintenance of concealed equipment, valves, controls, etc.
   2. Coordinate and prepare a location, size and function schedule for all required access doors. Access doors shall be of ample size, minimum 600mm x 600mm.

## 3.03 FIELD QUALITY CONTROL

A. Test:
   1. During the manufacture (at Contractor's premises only), installation and after completion of works; the system, sections of the system or its components shall be tested by the Contractor / Specialist Subcontractor in the presence of the Engineer, as directed below or elsewhere. The Contractor shall procure all testing instruments and accessories and bear all costs in connections with the same:
      a. Basic materials for conformity with the specified standards.
      b. Supports and anchors for ability to withstand required load.
      c. Wall mounted sanitary fixtures with a dead weight of 100 kgs.
      d. Filtration equipment for flow, head lose, filtration fineness, controls and alarms, regeneration etc.
      e. Control system for operating ranges, tolerances, cutout, alarms etc.
      f. Water supply systems for required flow and pressure at outlets, simulated peak flow conditions (open sectional control valves with estimated no. of outlets in open condition, in series).
      g. Drainage systems for simulated peak flow conditions and performance of trip seals (by simultaneous discharge of all water closets on the stack or groups).
      h. Piping in general for line, level and slopes.
      i. Sanitary fixtures for operation of fittings and proper fixation.

## 3.04 UTILITY CONNECTIONS

A. Coordinate with the relevant Client Authorities, obtain all necessary information on available utility mains, obtain approvals and permits and pay all fees and expenses in this respect.

B. Prepare coordinated working drawings and applications forms with all required information, submit to the relevant authorities and obtain their approval.

C. Arrange all materials, prepare site and execute / facilitate the execution of the connection, manholes etc. as directed by the relevant authorities.

D. Execute all manholes and road gullies within and outside the site boundary (on the utility line or otherwise) to local standards, in all respects.

E. Execute drop connections to sewerage manholes and provide benching at the bottoms as per regulation and latest detail drawing.

F. Execute drop connections to storm water manholes, when the drop exceeds 50 cm. Provide benching at the bottom, where required.

## 3.05 ADJUSTING

A. Balance and regulate the following items, systems
   1. Balancing valves in circulating systems for equal or proportionate flow.
   2. Thermostats for cut in cut out temperatures or range.
   3. Angle valves on fixtures supply for regulated flow.

B. Demonstrations
   1. Provide the services of a competent engineer to supervise the commissioning of all equipment and to train the Employer's personnel in all aspects of the same during a ten (10) working days period, during normal working hours. Allow for all costs in connection with the above.
   2. This shall only be done after substantial completion of the Project. Give a minimum of one week written notice and obtain Employer's written consent prior to such demonstrations.

# SECTION 220513
# COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

# SECTION 220513
# COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

## Part 1 - GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.02 SUMMARY

A. Section includes general requirements for single-phase and three phase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 415 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

### 1.03 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

### 1.04 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

### 1.05 QUALIFICATION

A. Motors are normally supplied as a part of the mechanical equipment assembly. Manufacturers of such motors shall be as selected/recommended by the equipment manufacturer.

### 1.06 REGULATORY REQUIREMENTS

A. Conform to applicable electrical code.

B. Store and protect products.

C. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. (For extended outdoor storage, remove motors from equipment and store separately).

## 1.07 WARRANTY, RESPONSIBILITIES, MAINTENANCE AND ACCEPTANCE

A. Refer to Annex A, showing schedule of equipment warranties, maintenance obligations and financial security.

## Part 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Motors:
   1. Siemens
   2. Allen Bradley
   3. AEG
   4. Brook Croption
   5. US Motors.
   6. PEL
   Or approved equal

### 2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Motors: Design for continuous operation in 55 degrees C environment, and for temperature rise in accordance with limits for insulation class, Service Factor, and motor enclosure type.

B. Visible Nameplate: Indicating motor horsepower, Voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model conduit connection in end frame.

C. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

D. Components such as fuses, contactor, indicator, timers etc. which may require replacement in future shall be product of the same standard or manufacturer as that of the electrical works for this project.

### 2.03 MOTORS

A. All motors (unless otherwise stated in particular clause/schedule) shall be of Totally Enclosed Fan Cooled (TEFC) type, cooled ventilation and liable to operate continuously and should comply to BS 2613.

B. All motors shall be squirrel cage induction type, with TEFC enclosures unless otherwise stated or dictated by Selection.

C. Provide anti-condensation heaters in stator windings for fire pumps and sump pump motors which are subjected to prolonged disuse.

D. The bearings of the motors shall be of a type requiring just one lubrication per year.

E. The ends of the windings shall reach a terminal box and arrangement shall be such as to allow for an easy permutation of the two phases leads without upsetting the compound when this is done at the ends of the cable.

F. Terminal boxes shall be fixed with a junction box, a cable inlet and an adaptor-plate such as required with necessary adjustments (cable pincers, etc) to suit the specified cable type.

G. Motors shall be supplied with foundations, bolts and sliding rails if necessary.

H. Rotation and colour of the phases shall comply with B.S. 158.

I. All motors shall have windings with class 'B' temperature rise and class 'F' insulation (unless otherwise stated in a particular clause/schedule).

J. Winding bridges, where used shall be tinned copper of adequate size and supplied by the manufacturer.

K. Motor name plates of etched aluminum shall state:
   1. Name of Manufacturer
   2. Serial Number and Frame Size
   3. Power, speed and power factor
   4. Electrical supply
   5. Type of starting.

   The name plate shall be attached to the body by riveting.

## 2.04 POWER FOR MOTORS

A. All motors shall be wound for the voltage sources indicated.

B. Motors and generators shall comply with BS-2613. Compliance of motors with typical tests by the manufacturer shall not free the Tenderer from his obligations to supply machines capable of operating their respective equipment under normal conditions of load.

C. Ambient temperature for motors and associated equipment installed in the buildings shall be 50 deg. C. for motors installed in the heating room and Diesel room ambient temperature will be 55 deg. C.

D. De-rating of motors shall be based on the above temperatures and climate conditions.

E. All motors shall have a power factor of 0.85 at 75% of its full load.

F. Automatic compensation system for the reactive power for all air conditioning motors is not required and the power factor of these motors will be 0.8 min.

G. Variations in voltage shall not exceed 6% (+ or -) of rated voltage.

H. Variations in frequency shall not exceed 4% (+ or -) of rated frequency.

I. Motors shall be designed to work for a period of at least five minutes at a voltage 25% under rated value and at a rated frequency without abnormal overheating.

## 2.05 START-UP OF MOTORS

A. All starters shall be of a manufacture meeting B.S.587 and insulated with materials of Class B.

B. Each motor shall be supplied with the required and appropriate starter subject to specific indication to the contrary.

C. Motor starters shall be protected from dust and vermin in a cast iron or steel sheet cabinet designed to be fixed to a wall, a floor or a panel according to requirements.

D. Starters shall be supplied with their push-buttons and a triple pole isolator interlocked with the opening of the cabinet.

E. All contacts of starters exposed to the air shall be strong and of silver or platinum, equipment shall be designed for working of 40 operations per hour.

F. Should the control equipment and the accessory appliances be supplied by a source other than the source of the motor circuit, insulation shall include and accessory contact so that should the motor be insulated, any source accessory to control equipment and to the motor shall also be insulated for all poles.

G. All push-buttons shall be of non-hygroscopic material and shall not swell.

H. Contacts of all switches and push-buttons shall be strong and have self-cleaning action when working.

I. All starters shall have a capacity of 40 operations per hours and shall be of an automatic contactor type unless specified otherwise.

J. All starters shall be supplied with auxiliary contacts so as to have an "ON" "OFF" indication at a distance.

K. Starters shall be supplied with cable glands.

## 2.06 TYPE OF START-UP

A. Starters for motors of up to 15 HP shall be of a "direct on line" type, and starting current in rated voltage shall not be greater than six times current under full load.

B. Should, for any reason, the above starting-up methods require too much starting-up time for a given motor, the Tenderer may submit other starting-up methods for approval.

## 2.07 PROTECTION OF MOTORS

A. General
   1. All solenoid shall be of the shaded pole pattern and of such construction that lamination noise is eliminated.

2. All relays shall be housed in cages easily accessible, built-in, dustproof and fixed onto the switch gear cell at eye level and shall be of an automatic return type and complying with B.S.142.
3. All tripping relays shall be supplied with indicators working mechanically so that the cause of the tripping shall be identified immediately. Design shall prohibit the indicator from falling before the relay has accomplished its full travel.
4. All thermal overload relays shall be automatically compensated for variations in ambient temperature.
5. All contacts shall be of silver, platinum or other approved substance.
6. Tripping circuits shall be capable of repeated operations without deteriorating and shall not be influenced by vibrations or external magnetic fields.

## 2.08 PROTECTION REQUIRED

A. On load pattern switch with H.R.C. cartridge fuses.

B. Under voltage release.

C. Protection from thermal over current and operation in single phase.

D. Protection from early leakage.

E. Open phase protection.

F. Over-current protection.

G. Short circuit protection.

## Part 3 - EXECUTION

3.01 Electric motors shall be installed as per manufacturer's recommendations.

3.02 Performance of electric motors shall be as per regulations.

# SECTION 220519
# METERS AND GAGES FOR PLUMBING PIPING

# SECTION 220519
# METERS AND GAGES FOR PLUMBING PIPING

## Part 1 - GENERAL

### 1.01 WORK INCLUDED

A. Thermometers and Fittings

B. Pressure Gauges and Fittings

### 1.02 RELATED SECTION

1. Division 21 – Section “Fire Protection specialties”.
2. Division 22 – Section “Plumbing Piping”.
3. Division 22 – Section “Domestic Water Pumps”.

### 1.03 REFERENCE STANDARDS

A. BS 1780 - Specification for Borden tube pressure and vacuum gauges.

### 1.04 QUALITY ASSURANCE

A. Products used in the works covered by this Section shall be provided from specialized manufacturer whose products have been in satisfactory use in similar service for minimum period of five (5) years.

### 1.05 SUBMITTALS

A. Product data, samples, shop drawings and manufacturer's installation instructions shall be submitted under provisions of the General Conditions of Contract.

### 1.06 DELIVERY, STORAGE AND HANDLING

A. Products shall be delivered to site, stored and protected under provisions of the Conditions of Contract.

B. Products shall General

C. be kept in shipping cartons until the time of installation.

D. Factory calibrated items which are dropped or subjected to shock otherwise, shall be kept in separate containers with appropriate labels till completion of works. A record of the same shall be kept for inspection by the Engineer.

## Part 2 - PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

A. Thermometers and Pressure Gauges
   1. Weiss Instruments Inc., USA
   2. WIKA, USA
   3. Dwyer Instruments, USA
   4. WATTS
   5. Ashcroft Inc.
   6. Honeywell.
   7. Terice, USA
   8. LMI, S.A
   9. Uni-Safe, USA
   Or approved equal

### 2.02 GLASS THERMOMETERS

A. Construction: Baked enamel finished, die-cast aluminium case; Mercury in glass capillary, V-shaped painted aluminum dial and spring secured glass front.

B. Connection: Straight form or 90 ° back angle form as required.

C. Stem: Brass or copper plated steel for separable socket, length to suit installation.

D. Scale: Permanently etched black lines and numerals on white non- reflective back ground, 230 mm (9 inches) long.

E. Calibration: Dual (°C and °F) with 10 °C (20 °F) maximum figure intervals and 1°C (2 °F)smallest graduations.

F. Accuracy: ± One scale division.

G. Range:
   1. Hot water: 0 to 114 °C (30 to 240 °F)
   Ref. : As manufactured Weiss Model # A 9 VU series

### 2.03 DIRECT READING DIAL THERMOMETERS

A. Construction: Gas filled type with phenol turret case; stainless steel movement; painted aluminum dial and spring secured shatter proof glass front.

B. Connection: Bottom or back as required.

C. Bulb: Rigid stainless steel with union, for separable socket; length to suit installation.

D. Scale: Permanently etched black lines and numerals on white non reflective background, 90 mm (3½ inch) diameter.

E. Calibration: Dual (°C and °F) with 10 °C (20 °F) maximum figure intervals and 1°C (2 °F) smallest graduation.

F. Accuracy: ± One scale division.

G. Range:
   1. Chilled water: - 6 to 82°C (20 to 180 °F)
   2. Hot water: 0 to 114°C (30 to 240 °F)

## 2.04 PRESSURE AND COMPOUND GAUGES

A. Construction: Phenol turret case; phosphor bronze Borden tube; stainless steel movement; painted aluminum dial and spring secured shatter proof glass front.

B. Connection: 15 mm (½ inch) nom. size, bottom or back as required.

C. Scale: Permanently etched black lines and numerals or white non- reflective background, 90 mm (3½ inch) diameter.

D. Calibration: Dual on the pressure side (Bars and psi) as well as vacuum side (mm and inches of mercury). Figure intervals shall be at 1 Bar (10 psi)) and smallest graduation shall not be more than 0.1 Bar (1 psi).

E. Accuracy: ± One (1) percent.

F. Range:
   1. At suction side of pumps: 760 mm - 0 - 4 Bars (30 inches - 0 - 60 psi)
   2. At discharge side of pumps: 200 percent of pump shut off head, but limited to 20 Bars (300 psi)

## 2.05 DIFFERENTIAL PRESSURE GAUGES FOR WATER

A. Construction: Phosphor Bronze bourdon tube type with stainless steel case with separation between dial chamber and fluid; painted aluminum dial; clear heavy glass facia; rubber pointer stops; over pressure restrictors; external, pointer zero adjustment etc.

B. Connections: 15 mm (½ inch), high and low pressure taps, at bottom (duplicated at top for air, gas)

C. Scale: Permanently etched / printed black lines and numerals on white non-reflective background, 114 mm diameter (minimum).

D. Calibration: Dual (Bars, feet of water), with figure intervals at 1 Bar (10 feet) and smallest graduation not exceeding 0.1 Bars (1.0 foot).

E. Accuracy: ± Three (3) % of full scale.

F. Range:
   1. 1.5 times of the working pressure but limited to 20 Bars (300 psi).

G. Accessories:

1. Copper capillary tubing with compression fittings
2. Isolating cocks (2 nos.)
3. Bleed fittings (2 nos.)
4. Surface mounting bracket

## 2.06 PRESSURE GAUGE ACCESSORIES

A. Cocks: bronze bar stock needle valves with female threaded ends.

B. Snubbers: Filter type, of brass / stainless steel construction with porous metal disc.

C. Siphon tubes: Straight coil constructed of schedule 40 steel; size and length as required.

## 2.07 WARRANTY

A. General Conditions of Contract to be referred to and complied with in respect of warranty requirements.

## Part 3 - EXECUTION

### 3.01 SELECTION AND INSTALLATION OF THERMOMETERS

A. Dial type thermometers shall be installed at the following locations.
   1. As shown on drawings.

B. Thermometers shall be installed with the dial in vertical, upright position and titled to give maximum readability.

### 3.02 SELECTION & INSTALLATION OF PRESSURE AND COMPOUND GAUGES

A. General: Pressure gauges shall be installed in piping tee, with gauge cock, at the most readable position. Gauges shall be selected with bottom side or rear inlet as appropriate.

B. Compound gauges shall be installed at the following locations:
   1. At the suction manifolds of packaged pump sets, end suction pumps & fire pumps.
   2. At the suction / suction header of unit pumps
   3. At the critical places subject to pressure variations and to the places as per engineers instructions.

C. Pressure gauges shall be installed at the following locations:
   1. At the discharge manifolds of packaged pump sets
   2. At the discharge of unit pumps
   3. At the inlet and outlet of water main (fresh, brackish & treated) incomers from ministries.
   4. At the inlet and outlet of each water heater.
   5. At the inlet and outlet of pressure reducing valve stations.
   6. At the critical places subject to pressure variations and to the places as per engineers instructions.

D. Pressure gauge cocks shall be installed on piping at the following locations. Outlet of these shall be plugged. The client shall be furnished with two (2) nos. pressure gauges of each type and range.
   1. At the inlet and outlet of central station discharge piping.
   2. At the inlet and outlet of hot water circulating pumps and pressure reducing valve stations.
   3. At the interface of water supply system with swimming pools, fountains, automatic irrigation system, etc.
   4. On the city water supply connection, in the vicinity of the break tank.

E. Snubbers shall be installed on all pressure gauges installed in close proximity of pump discharge.

F. Red set hands shall be provided, to indicate normal or critical pressure, in gauges subjected to variable pressures.

G. Remote reading type pressure gauges shall have armoured capillary tubes, when installed above 2 M (7 feet) from FFL.

## 3.03 SELECTION & INSTALLATION OF DIFFERENTIAL PRESSURE GAUGES

A. General: Differential pressure gauges shall be installed on custom made brackets attached to equipment assembly.

B. Differential pressure gauges (water) shall be installed across central water filters.

C. Gauges with adjustable switches shall be selected for interconnection with Building Management System (BMS), where required.

D. Snubbers shall be provided on all gauges for water.

E. Red set hands shall be provided to indicate normal or critical pressure in gauges subjected to variable pressures.

# SECTION 220523
# GENERAL DUTY VALVES FOR PLUMBING PIPING

# SECTION 220523
# GENERAL DUTY VALVES FOR PLUMBING PIPING

## Part 1 - GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.02 SUMMARY

A. Section Includes:
   1. Valve Actuators
   2. Angle Valves
   3. Ball Valves
   4. Butterfly Valves
   5. Check Valves (NRV)
   6. Gate Valves (IV)
   7. Globe Valves
   8. Regulating Valves (RV)

### 1.03 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Non rising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

### 1.04 SUBMITTALS

A. Product Data: For each type of valve indicated.

### 1.05 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   2. ASME B31.1 for power piping valves.
   3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

## 1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set angle, gate, and globe valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.
   5. Set butterfly valves closed or slightly open.
   6. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use Hand wheels or stems as lifting or rigging points.

## 1.07 WARRANTY, RESPONSIBILITIES, MAINTENANCE AND ACCEPTANCE

A. Refer to Annex A, showing schedule of equipment warranties, maintenance obligations and financial security.

## Part 2 - PRODUCTS

### 2.01 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 8 (DN 200)
2. Handwheel: For valves other than quarter-turn types. and larger.
3. Handlever: For quarter-turn valves NPS 6 (DN 150)
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head. and smaller.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch (50-mm)
1. Gate Valves: With rising stem. stem extensions and the following features:
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

### 2.02 BRONZE ANGLE VALVES

A. Class 150, Bronze Angle Valves with Bronze Disc (Upto diameter 50mm):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following but are not limited to, the following:
   a. Crane Co.
   b. Kitz Corporation.
   c. Nibco Inc.
   d. Milwauke Valve Company
   e. Watts Regulator Co.
   f. Econosto, Netherland
   g. Hattersley, U.K
   Or approved equal

2. Description:
    a. Standard: MSS SP-80, Type 1.
    b. CWP Rating: 230 psig (1590 kPa)
    c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
    d. Ends: Threaded.
    e. Stem and Disc: Bronze.
    f. Packing: Asbestos free.
    g. Handwheel: Malleable iron.

## 2.03 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim (up to diameter 50mm):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following but are not limited to, the following:
    a. Crane Co.
    b. Kitz Corporation.
    c. Milwaukee Valve Company.
    d. Nibco Inc.
    e. Pegler Hattersly
    f. Watts Regulator Co.
    g. Econosto, Netherland
    h. Hattersley, U.K
    Or approved equal

2. Description:
    a. Standard: MSS SP-110.
    b. SWP Rating: 230 psig (1590 kPa).
    c. CWP Rating: 600 psig (4140 kPa).
    d. Body Design: Two piece.
    e. Body Material: Forged brass.
    f. Ends: Threaded.
    g. Seats: PTFE or TFE.
    h. Stem: Stainless steel.
    i. Ball: Stainless steel, vented.
    j. Port: Full.

## 2.04 BRONZE LIFT CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Rubber Lined Disc (upto diameter50mm):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, but are not limited to, the following:
    a. Kitz Corporation.
    b. Milwaukee Valve Company.
    c. NIBCO INC.
    d. Watts.
    e. Pegler - Hattersley.

f. Crane Co.
g. Econosto, Netherland
h. Hattersley, U.K
Or approved equal

2. Description:
a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 230 psig (1590 kPa)
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze, Rubber Lined.

## 2.05 IRON SWING CHECK VALVES

A. Class 250, Iron Swing Check Valves with Metal Seats and external lever and weight:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, but are not limited to, the following (over diameter 50mm):
a. Crane Co.
b. Kitz Corporation.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Watts Regulator Co.
f. Econosto, Netherland
g. Hattersley, U.K
Or approved equal

2. Description:
a. Standard: MSS SP-71, Type I.
b. CWP Rating: 300 psig (2070 kPa)
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Gasket: Asbestos free.
h. Seat and Disc: Renewable type.

## 2.06 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, but are not limited to, the following (over diameter 50mm):
a. Milwaukee Valve Company.
b. NIBCO INC.
c. Watts Regulator Co.
d. Crane Co.

e. Kitz Corporation.
f. Econosto, Netherland
g. Hattersley, U.K
Or approved equal

2. Description:
a. Standard: MSS SP-125, MIL-V-18436F.
b. CWP Rating: 300 psig (2070 kPa)
c. Body Material: ASTM A 126, gray iron.
d. Style: Flange, globe style, spring loaded.
e. Seat: Bronze alloy or NBR.

## 2.07 BRONZE GATE VALVES

A. Class 150, RS Bronze Gate Valves (up to diameter 50mm):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, but are not limited to, the following:
a. Crane Co.
b. Kitz Corporation.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Watts Regulator Co.
f. Pegler - Hattersley.
g. Econosto, Netherland
h. Hattersley, U.K
Or approved equal

2. Description:
a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 230 psig (1590 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

## 2.08 IRON GATE VALVES

A. Class 250, OS&Y, Iron Gate Valves (over diameter 50mm):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, but are not limited to, the following:
a. Milwaukee Valve Company.
b. NIBCO INC.
c. Watts Regulator Co.
d. Pegler - Hattersley.
e. Crane Co.
f. Econosto, Netherland
g. Hattersley, U.K
Or approved equal

2. Description:
    a. Standard: MSS SP-70, Type I.
    b. CWP Rating: 230 psig (1590 kPa).
    c. Body Material: ASTM A 126, gray iron with bolted bonnet.
    d. Ends: Flanged.
    e. Trim: Stainless steel 316.
    f. Disc: Solid wedge.
    g. Packing and Gasket: Asbestos free.
    h. Seat and Disc: Renewable type.

## 2.09 BRONZE GLOBE VALVES

A. Class 150, Bronze Globe Valves with Nonmetallic Disc (up to diameter 50mm):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, but are not limited to, the following:
    a. Crane Co.
    b. Kitz Corporation.
    c. Milwaukee Valve Company.
    d. NIBCO INC.
    e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    f. Pegler.
    g. Econosto, Netherland
    h. Hattersley, U.K
    Or approved equal

2. Description:
    a. Standard: MSS SP-80, Type 2.
    b. CWP Rating: 230 psig (1590 kPa).
    c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
    d. Ends: Threaded.
    e. Stem: Bronze.
    f. Disc: PTFE or TFE.
    g. Packing: Asbestos free.
    h. Handwheel: Malleable iron.

## 2.10 IRON GLOBE VALVES

A. Class 250, Iron Globe Valves (over diameter 50mm):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, but are not limited to, the following:
    a. Crane Co.
    b. Milwaukee Valve Company.
    c. NIBCO INC.
    d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    e. Pegler .
    f. Econosto, Netherland
    g. Hattersley, U.K
    Or approved equal

2. Description:
    a. Standard: MSS SP-85, Type I.
    b. CWP Rating: 230 psig (1590 kPa).
    c. Body Material: ASTM A 126, gray iron with bolted bonnet.
    d. Ends: Flanged.
    e. Trim: Bronze.
    f. Packing and Gasket: Asbestos free.

## 2.11 REGULATING VALVE/DOUBLE REGULATING VALVE

A. Class 150, Bronze double regulating valve (up to diameter 50mm).

1. Manufacturers:
    a. Crane Co.
    b. Hattersley
    c. Singer
    d. TACO
    e. Bell
    f. Econosto, Netherland
    g. Hattersley, U.K
    Or approved equal

2. Description:
    a. Standard: BS 7350 & BS 5154 Series B
    b. CWP Rating: 230 psig (1590 kpa)
    c. Body Material: Bronze
    d. Bonnet: DZR & non-asbestos gasket
    e. Disk: DZR with PTFE insert
    f. Type: Y pattern with DZR throttling disk
    g. Ends: Threaded
    h. Setting: Up to 40 through 4 hand wheel resolution
    i. Accuracy: ± 5% when fully open

## 2.12 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, but are not limited to, the following:
    1. Babbitt Steam Specialty Co.
    2. Roto Hammer Industries.
    3. Trumbull Industries.
    4. Or approved equal

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
    1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
    2. Attachment: For connection to butterfly valve stems.
    3. Sprocket Rim with Chain Guides: Ductile or cast iron of type and size required for valve. Include zinc coating.
    4. Chain: Hot-dip, galvanized steel of size required to fit sprocket rim.

## Part 3 - EXECUTION

### 3.01 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

### 3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown. Locate valves for easy access and provide separate support where necessary.

B. Install valves in horizontal piping with stem at or above center of pipe.

C. Install valves in position to allow full stem movement.

D. Install chainwheels on operators for butterfly/gate/globe and plug valves [NPS 6 (DN 150)] <Insert size> and larger and more than 96 inches (2400 mm) above floor. Extend chains to60 inches (1520 mm) above finished floor.

E. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
   3. Lift Check Valves: With stem upright and plumb.

### 3.03 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

## 3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball, butterfly or gate valves.
   2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
   3. Throttling Service: Globe valves.
   4. Pump-Discharge Check Valves:
      a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze rubber lined disc.
      b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient seat check valves.
      c. NPS 2-1/2 (DN 65) and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
   1. For Copper Tubing, NPS 2 (DN 50)
   2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below. and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
   3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
   4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
   5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
   7. For Grooved-End Steel Piping: Valve ends may be grooved.

## 3.05 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50)
   1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends. and Smaller:
   2. Bronze Angle Valves: Class 150 disc.
   3. Ball Valves: Two piece full port bronze with stainless-steel trim.
   4. Bronze Swing Check Valves: Class 150 bronze disc.
   5. Bronze Gate Valves: Class 150 RS.
   6. Bronze Globe Valves: Class 150 bronze disc.

B. Pipe NPS 2-1/2 (DN 65)
   1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends. and Larger:
   2. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM/NBR seat, stainless-steel disc.
   3. Iron, Grooved-End Butterfly Valves: 300 CWP.
   4. Iron Swing Check Valves: Class 250 nonmetallic-to-metal seats.

5. Iron Swing Check Valves with Closure Control: Class 125, lever and weight.
6. Iron, Grooved-End Swing Check Valves: 300 CWP.
7. Iron, Center-Guided Check Valves: Class 250 compact-wafer/globe, resilient seat.
8. Iron, Plate-Type Check Valves: Class 250 dual plate; resilient seat.
9. Iron Gate Valves: Class 250 OS&Y.
10. Iron Globe Valves: Class 250.

## 3.06 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

A. Pipe NPS 2-1/2 (DN 65)
1. Iron Valves, and Larger: NPS 2-1/2 to NPS 4 (DN 65 to DN 100)
2. Iron Swing Check Valves: Class 250 metal seats. : May be provided with threaded ends instead of flanged ends.
3. Iron Swing Check Valves with Closure Control: Class 125, lever and spring/weight.
4. Iron, Grooved-End Swing Check Valves: 300 CWP.
5. Iron Gate Valves: Class 125 NRS.
6. Iron Globe Valves: Class 125.

# SECTION 220529
# HANGERS AND SUPPORTS FOR PLUMBING PIPING

# SECTION 220529
# HANGERS AND SUPPORTS FOR PLUMBING PIPING

## Part 1 - GENERAL

### 1.01 SUMMARY

A. Section Includes: Supports, anchors and seals complete in accordance with the requirements of the Contract Documents. Work includes but is not limited to the following:
   1. Horizontal-Piping Hangers and Supports.
   2. Vertical-Piping Clamps.
   3. Hanger-Rod Attachments.
   4. Building Attachments.
   5. Saddles and Shields.
   6. Spring Hangers and Supports.
   7. Miscellaneous Materials.
   8. Anchors.
   9. Equipment Bases.

### 1.02 REFERENCES

A. Manufacturer Standardization Society of the valve and fitting industry:
   1. MSS SP-58 : Pipe Hangers and Supports Materials, Design and Manufacturer.
   2. MSS SP-69 : Pipe Hangers and Support – Selection and Application.
   3. MSS SP-77 : Guidelines for Pipe Support Contractual Relationship.
   4. MSS SP-89 : Pipe Hangers and Support – Fabrication and Installation Practices.

B. Under Writers Laboratories (UL)
   1. Applicable Publications.

### 1.03 SUBMITTALS

A. Product Data: Submit catalogue cuts, specification, installation instructions and dimensioned drawings for each type of support, anchor and seal. Submit pipe hanger and support schedule showing manufacturers figure number, size, location and features for each required pipe hanger and support.

### 1.04 QUALITY ASSURANCE

A. Manufacturer Qualification: Firms regularly engaged in manufacture of supports and anchors, of type and size required whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Regulatory Requirements:
   1. UL and FM Compliance: Provide products which are Underwriters Laboratories listed and Factory Mutual approved.

## Part 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Saddles and Shields, Hayers & Supports
   1. B-Line System Inc.
   2. ITT Grinnel Corp., U.S.A.
   3. ANVIL
   4. TOLCO-NIBCO, U.S.A.
   5. HILTI
   6. FLAMCO
   7. Unistrut
      Or approved equal

B. The products or manufacturers listed here in are included for the purpose of establishing minimum quality standards.

### 2.02 MATERIALS

A. Horizontal – Piping Hangers and Supports
   1. General: Except as otherwise indicated, provide hot dipped galvanized factory fabricated horizontal-piping hangers and supports complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by the Contractor and approved by the Engineer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper piping systems. Use FM/UL type of Hangers for Fire Protection piping application.

B. Adjustable Steel Band Hanger: MSS type -10 for suspension of metallic non insulated or insulated stationary pipelines; 13mm to 50mm (½" to 2").

C. Adjustable Steel Clevises: MSS Type 1. For suspension of metallic non insulated or insulated stationary pipelines; 65mm to 250mm (2½" to 10").

D. Alloy Steel Pipe Clamps: MSS Type 2. For suspension of metallic high temperature pipe requiring up to 100mm (4") of insulation; 100mm to 400mm (4" to 16").

E. Steel Double Bolt Pipe Clamps: MSS Type 3. For suspension of metallic pipe requiring up to 100mm (4") of insulation and where flexibility of clamp is desirable; 19mm to 600mm (3/4" to 24").

F. Steel Pipe Clamps: MSS Type 4. For suspension of metallic cold pipe lines or hot pipe lines where little or no insulation is required; 13mm to 600mm (½" to 24").

G. Pipe Hangers: MSS Type 5. For suspension of metallic piping when off-center closure allowing installation of hanger before erection of piping is desired; 13mm to 100mm (½" to 4").

H. Adjustable Swivel Rings, Band Type: MSS Type 10. For suspension of metallic non insulated stationary pipe lines; 13mm to 50mm (½" to 2").

I. Split Pipe Rings: MSS Type 11. For suspension of metallic non- insulated stationary pipe lines; 10mm to 200mm (3/8" to 8").

J. Extension Split Pipe Clamps: MSS Type 12. For suspension of metallic non-insulated stationary pipe lines; 10mm to 75mm (3/8" to 3").

K. U-Bolt: MSS Type 24. For support of heavy loads; 13mm to 750mm (½" to 30").

L. Clips: MSS Type 26. For support of uninsulated piping not subject to expansion or contraction.

M. Pipe Slides and Slide Plates: MSS Type 35. For support of piping where horizontal movement resulting from expansion and contraction takes place and where low coefficient of friction is desired. Include one of the following plate types:
   1. Plate: Unguided type.
   2. Plate: Guided type.
   3. Plate: Hold-down clamp type.

N. Pipe Saddle Supports: MSS Type 36, including steel pipe base support and cast-iron floor flange. To support pipe from floor stanchion, using floor flange to secure stanchion to floor; 100mm to 1200mm (4" to 36").

O. Pipe Stanchion Saddles: MSS Type 37, including steel pipe base support and cast-iron floor flange. Equivalent to Type 36 except U-bolt provided for retaining pipe

P. Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast-iron floor flange. For stanchion type support where vertical adjustment is required; 63mm to 1200mm (2½" to 36").

Q. Adjustable Roller Hangers: MSS Type 43. For suspension of pipe from a single rod where horizontal movement may occur because of expansion or contraction; 150mm to 500mm (6" to 20").

R. Clips: For support of plastic pipes where longitudinal movement resulting from expansion and contraction may take place; proved heavy duty galvanized pipe ring in two halves swaged for good strength having screw clamping with acoustic insulated pre-fitted rubber inlay non-shifting type and solid, welded on nuts for clamping anchor rods M8 to M12 as required for pipe sizes; 15mm to 200mm.

## 2.03 VERTICAL-PIPING CLAMPS

A. General: Except as otherwise indicated, provide factory- fabricated vertical-piping clamps complying with ANSI/MSSSP-58, of one of the following types listed,

selected by the Contractor and approved by the Engineer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper piping systems.

B. Two-Bolt Riser Clamps: MSS Type 8. For support and steadying of pipe risers; 19mm to500mm (3/4" to 20"). Also supports pipe covering or insulation.

C. Four-Bolt Riser Clamps: MSS Type 42. When longer ends are required for riser clamps.

D. Clips: For support of plastic pipes provide pipe ring in two halves clamping with screw and pre-fitted rubber inlay and solid welded on nuts for clamping anchor rods for pipes 15mm to 200mm.

## 2.04 HANGER-ROD ATTACHMENTS

A. General: Except as otherwise indicated provide factory- fabricated hanger-rod attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by the Contractor and approved by the Engineer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

B. Steel Turnbuckles: MSS Type 13. To provide adjustment up to 150mm (6") for heavy loads.

C. Steel Clevises: MSS Type 14. For use on high temperature piping installations.

D. Swivel Turn buckles: MSS Type 15. To be used with split pipe rings, MSS Type 11.

E. Malleable Iron Sockets: MSS Type 16. For attaching hanger rod to various types of building attachments.

F. Steel Weld less Eye Nuts: MSS Type 17. For use on high temperature piping installations.

## 2.05 BUILDING ATTACHMENTS

A. General: Except as otherwise indicated, provide factory fabricated building attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by the Contractor and approved by the Engineer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper piping systems.

B. Concrete Inserts: MSS Type 18. For upper attachment for suspending pipe hangers from a concrete ceiling.

C. Top Beam C-Clamps: MSS Type 19. To be used under roof installations with bar joist construction, for attachment to top flange of structural shape.

D. Side Beam or Channel Clamps: MSS Type 20. For attachment to bottom flange of beams, channels, or angles.

E. Center Beam Clamps: MSS Type 21. For attachment to center of bottom flange of beams.

F. Welded Attachments: MSS Type 22. For attachment to bottom of beams where loads are considerable and rod sizes are large.

G. C-Clamps: MSS Type 23. For attachment to structural shapes.

H. Top I-Beam Clamps: MSS Type 25. For attachment to top of beams when hanger rod is required tangent to edge of flange.

I. Side I-Beam Clamps: MSS Type 27. For attachment to bottom of steel I-beams.

J. Steel I-Beam Clamps with eye Nut: MSS Type 28. For attachment to bottom of steel I beams for heavy loads.

K. Steel WF-Beam Clamps with eye Nut: MSS Type 29. As Type 28 with link extensions.

L. Malleable Beam Clamps: MSS Type 30. For attachment to structural steel.

M. Steel Brackets: One of the following for indicated loading. To be used for support from below, or by using clip and rod for suspending from above. Light duty: 340 Kg. (750 lbs.), Medium: 680 Kg. (1500 lbs.), Heavy: 1360 Kg. (3000 lbs.).
   1. Light Duty: MSS Type 31.
   2. Medium Duty: MSS Type 32.
   3. Heavy Duty: MSS Type 33.

N. Side Beam Brackets: MSS Type 34. For use on sides of steel or wooden beams.

O. Plate Lugs: MSS Type 57. For attachment to steel beams where flexibility at the beam is desired.

P. Horizontal Travelers: MSS Type 58. For supporting piping systems subject to linear horizontal movements where head room is limited.

## 2.06 SADDLES AND SHIELDS

A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory- fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

B. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.

C. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

D. Thermal Hanger Shields: Constructed of 360‘ insert of high density, 690 KPa (100 psi),waterproofed calcium silicate, encased in 360‘ sheet metal shield. Provide assembly of same thickness as adjoining insulation.

## 2.07 MISCELLANEOUS MATERIALS

A. Metal Framing: Provide products complying with NEMA STD ML 1.

B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.

C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of one (1) part cement to three (3) parts sand, by volume, with minimum amount of water required for placement and hydration.

D. Heavy Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.

E. Pipe Guides: Provide factory-fabricated guides, of cast semi steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any) and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

## Part 3 - EXECUTION

### 3.01 PREPARATION

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.

B. Prior to installation of hangers, supports, anchors and associated work, the Contractor shall meet at project site with inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this Section, and the Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

### 3.02 INSTALLATION OF BUILDING ATTACHMENTS

A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in Drawing MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints and at changes in direction of piping. Provide concrete inserts, where required to be installed before structural concrete is placed.

### 3.03 INSTALLATION OF HANGERS AND SUPPORTS

A. General
   1. Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping and do not support piping from other piping.

   2. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
   3. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized approved methods.

B. Provisions for Movement
   1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors and to facilitate action of expansion joints, expansion loops, expansion bends and similar units. Contractor to check and confirm that loads from equipment, piping etc can be safely accommodated by structure.
   2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
   3. Pipe Slopes: Install hangers and supports to provide required pipe slopes and so that maximum pipe deflections allowed by ANSI B31 are not exceeded.

C. Insulated Piping
   1. Comply with the following installation requirements.
      a. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSIB31.
      b. Shields: Where low-compressive-strength insulation or vapour barriers are indicated on cold or chilled water piping, install coated protective shields. For pipe 200mm (8”) and over, install wood insulation saddles.
      c. Saddles: Where insulation without vapour barrier is indicated, install protection saddles.

## 3.04 INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer’s written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

D. Anchor Spacings: where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

## 3.05 ADJUSTMENT OF HANGERS AND SUPPORTS

A. Adjust hangers and supports and place grout as required under supports to bring piping to proper levels and elevations.

## 3.06 EQUIPMENT BASES

A. Construct suitable concrete bases for the elevated support of all floor mounted equipment. Furnish, for the Engineer's approval, scaled layouts of all required bases, with dimensions and location to column center lines, and templates, anchors bolts and accessories, necessary for base construction.

B. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of approved structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands.

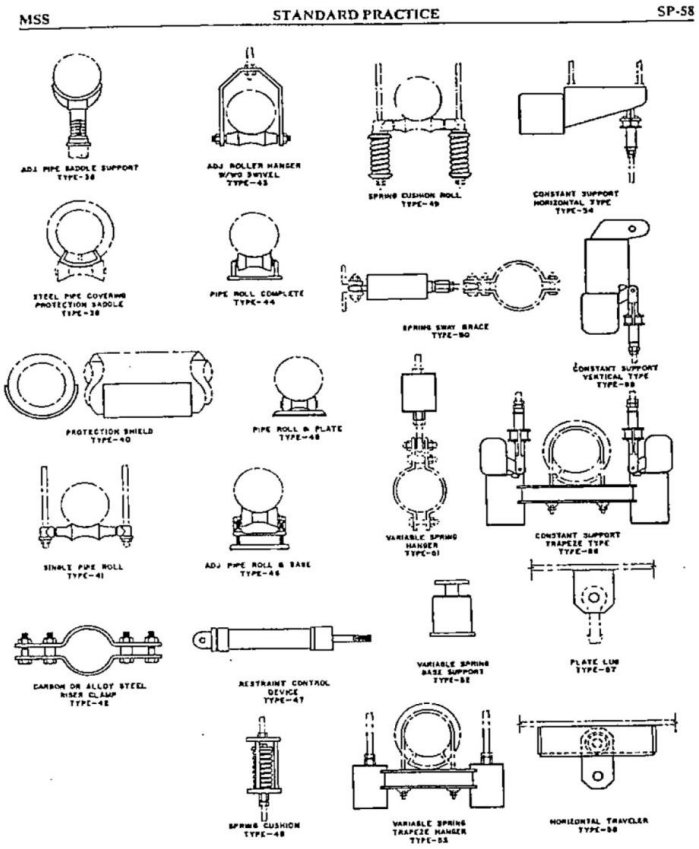



FIGURE 1. TYPE CHART (Continued)

# SECTION 220553
# IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

# SECTION 220553
# IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

## Part 1 - GENERAL

### 1.01 SUMMARY

A. Section Includes:
   1. Mechanical identification devices complete in accordance with the requirements of the Contract Documents. Work includes but is not limited to the following:
      a. Painted Identification Materials.
      b. Plastic Pipe Markers.
      c. Plastic Tape.
      d. Valve Tags.
      e. Valve Schedule Frames.
      f. Engraved Plastic-Laminate Signs.
      g. Plasticized Tags.

### 1.02 REFERENCES

A. American National Standards Institute:
   1. ANSI 13.1 “Letting Colours and Viewing Angles of Identification Devices”.

B. Occupational Safety and Health Administration (OSHA)
   1. Relevant parts of the publication.

### 1.03 SUBMITTALS

A. Product Data: Submit to Engineer for information only, product specifications and installation instructions for each identification material and device required.

B. Samples: Submit samples of each colour, lettering style and other graphic representation required for each identification material or system.

C. Schedule: Submit valve schedule for each piping system, typewritten and reproduced on A4 size paper bound. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any).Mark valves which are intended for emergency shut-off and similar special uses, by special “flags”, in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals.

### 1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms regularly engaged in manufacturer of identification devices of type and size required, whose products have been in satisfactory use in similar service for not less than five (5) years.

## 1.05 MAINTENANCE

A. SPARE PARTS
1. Deliver spare parts to Employer stores.
2. Obtain Engineers approval for the delivered spare parts.

## Part 2 - PRODUCTS

### 2.01 MANUFACTURER

A. Mechanical Identification
   1. Apple baum Tag & Lable (U.S.A.)
   2. Brady (WH) Co., Sign mark Div.,
   3. Seton Name Plate Corp. (U.S.A.)
      Or approved equal

B. The products or manufacturers listed herein are included for the purpose of establishing minimum quality standards.

### 2.02 MATERIALS

A. Mechanical Identification Materials
   1. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Sections. Where more than single type is specified for application, selection is Contractor's option, and as approved by the Engineer, but provide single selection for each product category.

B. Painted Identification Materials
   1. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI/ASME A31.1 for piping and similar applications, but not less than 32mm (1-1/4") high letters for ductwork, and not less than 19mm (3/4") high letters for access door signs and similar operational instructions.
   2. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

   3. Identification Paint: Standard identification enamel of colours indicated or, if not otherwise indicated for piping systems, comply with ANSI A13.1 for colours.

C. Plastic Pipe Markers:
   1. General: Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, colour coded, plastic-sheet pipe markers, complying with ANSI A13.1 and as follows:
      a. Small Pipes: For external diameters less than 150mm (6") (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
         i) Snap on application of pre-tensioned semi-rigid plastic pipe marker.
         ii) Adhesive lap joint in pipe marker overlap.
         iii) Laminated or bonded application of pipe marker to pipe (or insulation).

iv) Taped to pipe (or insulation) with colour-coded plastic adhesive tape, not less than 19mm (3/4") wide; full circle at both ends of pipe marker, tape lapped 38mm (1-1/2").

b. Large Pipes: For external diameters of 150mm (6") and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than three times letter height (and of required length), fastened by one of the following methods:
   i) Laminated or bonded application of pipe marker to pipe (or insulation).
   ii) Taped to pipe (or insulation) with colour-coded plastic adhesive tape, not less than 38mm (1-1/2") wide; full circle at both ends of pipe marker, tape lapped 75mm (3").
   iii) Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

c. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.
   i) Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

D. Plastic Tape:
1. General: Manufacturer's standard colour-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 0.07mm (3 mils) thick.
   a. Width: Provide 38mm (1-1/2") wide tape markers on pipes with outside diameters (including insulation, if any) of less than 150mm (6"); 63mm (2-1/2") wide tape for larger pipes.
   b. Colour: Comply with ANSI A13.1/BS, except where another colour selection is indicated and as approved by the Engineer.

E. Valve Tags:
1. Brass Valve Tags: Provide 19 gauge polished brass valve tags with stamp-engraved piping system abbreviation in 6mm (1/4") high letters and sequenced valve numbers 13mm (1/2") high, and with 4mm (5/32") hole for fastener.
   a. Provide 38mm (1-1/2") diameter tags, except as otherwise indicated.
   b. Fill tag engraving with black enamel.
2. Valve Tag Fasteners: Manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

F. Valve Schedule Frames: For each page of the valve schedule, provide a glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

G. Engraved Plastic-Laminate Signs:
1. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter colour) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

a. Thickness: 1.6mm (1/16”) for units up to .013 Sq .m (20 Sq. in.) or 200mm (8”) length; 3mm (1/8”) for larger units.
b. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2. Plasticized Tags
   a. General: Manufacturer’s standard pre-printed or partially pre-printed accident prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 81mm x 140mm (3-1/4” x 5-5/8”), with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE) in English and Urdu.

## 2.03 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled and comply with ANSI A.13.1 for lettering size, colours and viewing angles of identification devices. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
   1. Multiple Systems: Where multiple systems of same generic name and specified, provide identification which indicates individual system number as well as service (as examples; Air Supply No. 1H, Standpipe F12).
   2. Provide lettering and wording in both Urdu and English.

## 2.04 COLORS

A. Requirements of the reference standards shall be conformed to, unless otherwise indicated.

B. Co-ordinated schedule shall be made in agreement with all other similarly identified services, avoiding confusing repetitions.

C. Prevailing governmental regulations shall be complied with, where appropriate, like for gas piping.

D. Following colors shall be construed to mean as colors defined by the BS color numbers (the color names given are adapted from the Dulux range of the ICI Company, UK for reference only).

| Sl. No. | Color Names | Abbreviation | BS Colour No. |
|---|---|---|---|
| 1. | White | Wt | 00 E 55 |
| 2. | Portland Grey | PG | 00 A 01 |
| 3. | Goosewing Grey | WG | 00 A 05 |
| 4. | Flint Grey | FG | 00 A 09 |
| 5. | Larkspur Blue | LB | 18 E 51 |
| 6. | Regatta Blue | RB | 18 E 53 |
| 7. | Viking Blue | VB | 20 C 37 |
| 8. | Midnight Blue | MB | 20 C 40 |

| | | | |
|---|---|---|---|
| 9. | Trafalgar Blue | TB | 20 D 45 |
| 10. | Cornflower Blue | CB | 20 E 51 |
| 11. | Orchard Green | OG | 12 C 39 |
| 13. | Leaf Green | LG | 12 D 43 |
| 14. | Citrine Green | CG | 12 E 51 |
| 15. | Linden Green | NG | 12 E 53 |
| 16. | Garland Green | GG | 14 E 51 |
| 17. | Verona Green | VG | 14 E 53 |
| 18. | Willow Green | WG | 12 B 17 |
| 19. | Aztec Yellow | AY | 10 E 53 |
| 20. | Goldcup Yellow | GY | 08 E 51 |
| 21. | Cameo Cream | CC | 06 C 33 |
| 22. | Cinnamon Cream | IC | 06 C 37 |
| 23. | Nectar Cream | NC | 06 E 56 |
| 24. | Shell Pink | SP | 04 C 33 |
| 25. | Orange | Or | 06 E 51 |
| 26. | Azalia Red | AR | 04 E 51 |
| 27. | Poppy Red | PR | 04 E 53 |
| 28. | Monarch Red | MR | 04 D 45 |
| 29. | Black | Bk | 00 E 53 |

## 2.05 PIPE MARKERS

A. 150 mm (6 inch) wide band of colors (as scheduled below); using two ply, self adhesive vinyl tapes with 12 mm (½ inch) overlap; shall be applied around the pipes.

B. External Utilities

| | |
|---|---|
| 1. Client Fresh Water | Wt / LG / Wt |
| 2. Client Brackish Water | Wt / TB / Wt |
| 3. Fresh Water Distribution | Wt / GG / Wt |
| 4. Brackish Water Distribution | Wt / CB / Wt |
| 5. Fire Protection Water Supply | Wt / PR / Wt |

C. Landscape Irrigation System

| | |
|---|---|
| 1. Pressure Lines to Spray Zones | Wt / CB / Wt |
| 2. Pressure Lines to Drip Zones | CB / Wt / CB |

D. Fire Protection System

| | |
|---|---|
| 1. Fire Protection Water Supply | Wt / PR / Wt |
| 2. Hose Reel System | Wt / AR / Wt |
| 3. Wet Standpipe System | Wt / PR / Wt |
| 4. Sprinkler System | Wt / MR / Wt |

E. Plumbing Services

| | |
|---|---|
| 1. Filtered Fresh Water | Wt / VG / Wt |
| 2. Fresh Water Supply | Wt / GG / Wt |
| 3. HVAC Cooling Tower Make-up Supply | Wt / FG / Wt |
| 4. HVAC Chilled Water Make-up Supply | FG / Wt / Wt |
| 5. Cold Water Supply | Wt / GG / Wt |
| 6. Hot Water Supply | Wt / Or / Wt |
| 7. Hot Water Return | Wt / SP / Wt |

| | |
|---|---|
| 8. Soil and Waste Pipes | Wt / Bk / Wt |
| 9. Vent Pipes | Wt / AY / Wt |
| 10. Rain Water Pipes | Wt / CC / Wt |
| F. Fuel Gas Supply | |
| 1. Liquified Petroleum Gas | GY / WG / GY |
| 2. Fuel Gas Supply | GY / Wt / GY |
| 3. Natural Gas | GY / WN / GY |

## 2.06 DIRECTIONAL ARROWS

A. Two-ply, self adhesive vinyl strip markers of size 50 x 150 mm (minimum) with white arrows on background of respective colors shall be provided to indicate direction of flow in pipes.

## Part 3 - EXECUTION

### 3.01 APPLICATION AND INSTALLATION

A. General Installation Requirements
1. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

B. Ductwork Identification
1. General: Identify air supply, return, exhaust, smoke, ventilation, intake and relief ductwork with stenciled signs and arrows, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork paint colour).

2. Location: In each space where ductwork is exposed, or concealed locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 15m (50') spacings along exposed runs.
3. Access Doors: Provide stenciled or plastic-laminate type signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

C. Piping System Identification
1. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:
    a. Stenciled markers, including colour-coded background band or rectangle, and contrasting lettering of black or white. Extend colour band or rectangle 50mm (2") beyond ends of lettering.
    b. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non insulated pipes.
2. Locate pipe markers and colour bands for all pipework in all spaces such as machine rooms, accessible maintenance spaces (shafts, tunnels, plenums), exterior and concealed locations.
    a. Near each valve and control device.
    b. Near each branch, excluding short take offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
    c. Near locations where pipes pass through walls or floors/ceilings, or enter non accessible enclosures.
    d. At access doors, manholes and similar access points which permit view of concealed piping.
    e. Near major equipment items and other points of origination and termination.

f. Spaced intermediately at maximum spacing of 15m (50') along each piping run, except reduce spacing to 7.5m (25') in congested areas of piping and equipment.
g. On piping above acoustical ceilings.

D. Valve Identification
1. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, and shut-off valves at HVAC terminal devices and similar rough-in connections of endues fixtures and units. List each tagged valve in valve schedule for each piping system.
2. Tagging Schedule: Provide tagging schedule to the approval of the Engineer.

3. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by the Engineer.
   a. Where more than one major machine room is shown for the Project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than single machine room.

E. Mechanical Equipment Identification
1. General: Install engraved plastic laminate sign on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
   a. Main control and operating valves, including safety devices and hazardous units.
   b. Meters, gages, thermometers and similar units.
   c. Pumps and similar motor driven units.
   d. Coils, evaporators.
   e. Tanks and pressure vessels, air separators and sand filters.
   f. Chemical treatment equipment and piping.
2. Optional Sign Types: Where lettering larger than 25mm (1") height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at Contractor's option.
3. Lettering Size: Minimum 6mm (1/4") high lettering for name of unit where viewing distance is less than 600mm (2' -0"), 13mm (1/2") high for distances up to 1800mm (6' -0"), and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to ¾ the size of principal lettering.
4. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicated safety and emergency precautions, and warn of hazards and improper operations.
5. Optional Use of Plasticized Tags: At the Contractor's option, where equipment to be identified is concealed above acoustical ceilings or similar concealment, plasticized tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment).

# SECTION 220719
# PLUMBING PIPING INSULATION

# SECTION 220719
# PLUMBING PIPING INSULATION

## PART 1 – GENERAL

### 1. 1 SUMMARY

A. Section Includes:
1. Closed-cell elastomeric insulation for domestic hot water PPR piping.
2. Mineral (rock) wool insulation for diesel generator exhaust piping.
3. Insulation adhesives, vapor barriers, protective jacketing, and accessories required for a complete installation.

### 1. 2 REFERENCES

Comply with the latest editions of the following standards:
- ASTM C534 – Flexible Elastomeric Cellular Thermal Insulation.
- ASTM C547 – Mineral Fiber Pipe Insulation.
- ASTM C795 – Thermal Insulation for Stainless Steel.
- ASTM E84 – Surface Burning Characteristics.
- EN 14304 – Elastomeric Thermal Insulation Products.
- EN 14303 – Mineral Wool Thermal Insulation Products.
- EN 13501-1 – Fire Classification of Construction Products.
- ASHRAE 90.1 – Energy Standard for Buildings.

### 1. 3 SUBMITTALS

Submit the following:

A. Manufacturer's Product Data.

B. Technical Data Sheets.

C. Shop Drawings indicating insulation thicknesses and installation details.

D. Samples of insulation and protective jacketing upon request.

E. Manufacturer's installation instructions.

F. Warranty certificate.

### 1. 4 QUALITY ASSURANCE

A. Products shall be manufactured by companies having a minimum of five (5) years' experience in the production of insulation materials.

B. All insulation materials shall be new, factory manufactured, and installed in accordance with the manufacturer's recommendations.

## 1. 5 DELIVERY, STORAGE AND HANDLING

A. Deliver insulation materials in original unopened packages.

B. Store indoors in a clean, dry location protected from sunlight, moisture, chemicals and physical damage.

## 1. 6 WARRANTY, RESPONSIBILITIES, MAINTENANCE AND ACCEPTANCE

A. Refer to Annex A, showing schedule of equipment warranties, maintenance obligations and financial security.

## PART 2 – PRODUCTS

### 2.1 CLOSED-CELL ELASTOMERIC INSULATION (FOR HOT WATER PPR PIPING)

**Manufacturers**

- Armacell (ArmaFlex)
- K-FLEX
- Aeroflex
- NMC
- Approved equivalent

**Material**

- Flexible closed-cell elastomeric foam (NBR/PVC or EPDM).
- Factory-made tubular insulation.
- Fiber-free.
- CFC/HCFC free.
- Resistant to mold and moisture.

**Physical Properties**

- Thermal Conductivity:
  - ≤0.036 W/m·K at 0°C
  - ≤0.040 W/m·K at 40°C
- Density: **45–70 kg/m³**
- Water Vapor Resistance Factor (μ): **≥7000**
- Closed Cell Content: **≥95%**
- Service Temperature: **−50°C to +110°C**
- Fire Classification: **Euro class B-s3, d0** or ASTM E84 Class A.

**Minimum Thickness**

| Pipe Size | Thickness |
|---|---|
| DN15–DN25 | 20 mm |
| DN32–DN50 | 25 mm |
| DN65–DN100 | 32 mm |
| DN125 and above | 40 mm |

**Accessories**

Provide compatible adhesive, sealing tape, fittings, vapor barrier sealant and PVC or aluminum protective jacket where exposed.

## 2.2 MINERAL (ROCK) WOOL INSULATION (FOR DIESEL GENERATOR EXHAUST PIPING)

**Manufacturers**

- ROCKWOOL
- Knauf
- Owens Corning
- ISOVER
- Approved equivalent

**Material**

- High-density preformed rock wool pipe insulation.
- Non-combustible.
- Hydrophobic.
- Suitable for high-temperature exhaust systems.

**Physical Properties**

- Density: **80–100 kg/m³**
- Thermal Conductivity: **≤0.040 W/m·K**
- Maximum Service Temperature: **650°C minimum**
- Melting Point: **>1000°C**
- Fire Classification: **Euro class A1**

**Minimum Thickness**

| Pipe Size | Thickness |
|---|---|
| DN40–DN80 | 50 mm |
| DN100–DN200 | 75 mm |
| DN250 and above | 100 mm |

**Protective Jacketing**
Provide **0.80 mm stucco embossed aluminum cladding** complete with stainless steel bands, elbows, end caps, flashings and weatherproof sealing.

## PART 3 – EXECUTION

### 3. 1 EXAMINATION

Verify piping installation has been completed and pressure tested before installing insulation.

### 3. 2 INSTALLATION

A. Install insulation in accordance with the manufacturer's written instructions.

B. Install insulation continuously over all piping, fittings, valves, flanges and accessories.

C. Seal all longitudinal and circumferential joints with manufacturer's approved adhesive or tape.

D. Install removable insulated covers on valves, flanges and equipment requiring maintenance.

E. Protect outdoor insulation with aluminum cladding or other approved weatherproof finish.

### 3. 3 FIELD QUALITY CONTROL

A. Inspect insulation for continuity, proper thickness and secure attachment.

B. Repair damaged insulation before project completion.

C. Replace insulation that is wet, damaged or improperly installed.

### 3. 4 CLEANING AND PROTECTION

A. Remove all installation debris.

B. Clean finished insulation surfaces.

C. Protect completed insulation from damage until final project acceptance.

# SECTION 221116
# DOMESTIC WATER PIPING

# SECTION 221116
# DOMESTIC WATER PIPING

## Part 1 - GENERAL

### 1.01 SUMMARY

A. Section Includes:
1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Encasement for piping.
3. Specialty valves.
4. Flexible connectors.
5. Water meters furnished by utility company for installation by Contractor.
6. Water meters.

B. Related Section:
1. Division 22 Section "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

### 1.02 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions.

### 1.03 SUBMITTALS

A. Section Includes:
1. Water meters.
2. Backflow preventers, Vacuum breakers Backflow preventers and vacuum breakers.

B. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
1. Fire-suppression-water piping.
2. Domestic water piping.
3. HVAC hydronic piping.

C. Field quality-control reports.

### 1.04 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with BS:EN (British European) standards for potable domestic water piping and components.

## 1.05 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

## 1.06 WARRANTY, RESPONSIBILITIES, MAINTENANCE AND ACCEPTANCE

A. Refer to Annex A, showing schedule of equipment warranties, maintenance obligations and financial security.

## Part 2 - PRODUCTS

### 2.01 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Approved Manufacturers
   1. Bor-Plus
   2. Polymutan
   3. Kelen
   4. Unidelto – Italy
   5. Wirsbo – Sweden
   6. Uponor - Germany
      Or approved Equal

### 2.02 PPR PIPING

A. Hot & Cold water Pipes and fittings:

B. PN-25 polypropylene pipes with multilayer with fiber manufactured with compliance to the DIN 8077/8078, and Fittings to the DIN 16962 with a PN-25 pressure class.

C. Pipes and fittings shall be joined by poly- fusion method, using a fusion welding machine as per pipe manufacturer's recommendation, as suitable for their piping system.

D. Threaded fittings shall be used to connect to other piping systems, fixtures, etc., fitting with metal insert shall be sealed with Teflon tape, and all PPR fittings with metal inserts should be made of Brass plated by a nickel layer.

E. PP-R piping system shall be installed with special pre-caution for thermal expansion especially for exposed installation, thermal expansion coefficient of the selected material should not exceed 0.035mm/m.K.

F. All pipes and fitting used to transport the hot water should be insulated as per the DIN1988, thermal conductivity of the selected material should not exceed 0.21W/m.C

G. All PP-R pipes shall not be installed or stored under direct UV light. Pipes on roof shall be insulated and cladded (UV protection)

H. Pipe bending shall be generally avoided, PP-R pipes and fittings shall be certified for potable water use by a recognized European Standard. DVGW or approval equivalent.

I. All system components should be able to resist an emergency operating temperature up to 110C. Pipes and fittings should be produced by the same manufacturer using the same raw material source with the natural color of the polypropylene without any additives or coloring of the pipes and fittings. Contractor to ensure that the velocity of the flow will not exceed the 1.5m/s inside the floors and not to exceed the 2.0m/s in riser pipes. In order to minimize the friction and pressure losses in the network only elbows with Non-centric profiles shall be used.

## 2.03 PEX TUBE AND FITTINGS (Not Applicable)

A. Cold and hot water distribution pipe work embedded within builder's work inside toilets, bathrooms, kitchen shall be composed of :

B. PN20 Cross linked polyethylene pipe according to DIN 16892 and 16893 and should be NSF approved and should comply with the requirements of the ASTM F876/877 pulled in a corrugated conduit of ordinary polyethylene. Fittings of DZR construction. Proposed pipes should be DVGW & AENOR approved.

C. The Inner Pipe shall be a cross linked polyethylene. Pipe withstanding up to 95 deg. °C at a max. Pressure of 10 bar without deformation or Damage. Short time temperature loading up to 110deg.C

D. Pipes manufacturer shall offer 50 years grantee for the pipes and 10 years for the complete system.

E. All pipes shall be stamped on equal intervals showing clearly the name of the manufacturers along with the pressure and temperature rating of these pipes

F. All pipes shall be laid so that the 16mm PEX water pipe can be replaced if necessary.

G. Fittings& Accessories:
   1. Pipes shall be connected to the different fittings via a wall box of reinforced plastic fitted with bronze elbow suitable for 15mm or 20mm threaded connection. The box should be suitably designed in order to enable the replacement of existing pipes in the event of their damage.
   2. Both pipes and fittings to be produced by the same manufacturer.

## 2.04 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.”

## 2.05 TRANSITION FITTINGS

A. General Requirements:
   1. Same size as pipes to be joined.
   2. Pressure rating at least equal to pipes to be joined.
   3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

## 2.06 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:
   1. Description:
      a. Pressure Rating: 150 psig.
      b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
   1. Description:
      a. Pressure Rating: 150 psig.
      b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric Couplings:
   1. Description:
      a. Galvanized-steel coupling.
      b. End Connections: Female threaded.
      c. Lining: Inert and noncorrosive, thermoplastic.

## 2.07 FLEXIBLE CONNECTORS

A. Manufacturers: Refer to Appendix A

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
   1. Working-Pressure Rating: Minimum 200 psig
   2. End Connections 50mm and Smaller: Threaded copper pipe or plain-end copper tube.
   3. End Connections 65mm and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.
   1. Working-Pressure Rating: Minimum 200 psig.
   2. End Connections 50mm and Smaller: Threaded steel-pipe nipple.
   3. End Connections 65mm and Larger: Flanged steel nipple.

## 2.08 WATER METERS.

A. Displacement-Type Water Meters:
   1. Manufacturers:
      a. Hunter
      b. Wiess
      c. Winters
         Or approved Equal

   2. Description:
      a. Standard: AWWA C700.
      b. Pressure Rating: 150 psig working pressure.
      c. Registration: In gallons or cubic meters as required by utility.
      d. Case: Bronze.
      e. End Connections: Threaded.

## Part 3 - EXECUTION

### 3.01 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

### 3.02 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.

C. Install shutoff valve immediately upstream of each dielectric fitting.

D. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure reducing valves.

E. Install domestic water piping level with 0.25 percent slope downward toward drain.

F. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

G. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

I. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

K. Install piping adjacent to equipment and specialties to allow service and maintenance.

L. Install piping to permit valve servicing.

M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install PEX piping with loop at each change of direction of more than 90 degrees.

Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

R. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

S. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.

T. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

## 3.03 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
   2. PVC Piping: Join according to ASTM D 2855.

H. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

## 3.04 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping 50mm and smaller. Use butterfly or gate valves for piping 65mm and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
   1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
   2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping 50mm and smaller and butterfly valves for piping 65mm and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

## 3.05 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:
   1. 40mm and Smaller: Fitting-type coupling.
   2. 50mm and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping 50mm and Smaller: Plastic-to metal transition fittings.

## 3.06 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

## 3.07 FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.

B. Install stainless-steel-hose flexible connectors in steel domestic water piping.

## 3.08 WATER METER INSTALLATION

A. Rough-in domestic water piping for water meter installation according to utility company's requirements.

B. Install displacement-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.

C. Install remote registration system according to standards of utility company and of authorities having jurisdiction.

## 3.09 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 10mm.

E. Install EPDM rubber lined hangers for hot and cold piping with the following maximum horizontal spacing and minimum rod diameters:
   1. 25mm to 50mm and Smaller: 10-mm rod.
   2. 50mm to 200mm 13-mm rod.

F. Install supports for vertical piping every 1500 mm for 50mm and smaller, and every 1800mm.

G. Install rubber lined hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. 50mm and Smaller: 1200 mm.
   2. 65mm to 150mm 48 inches -1200 mm13-mm rod.

H. Install supports for vertical PVC piping every 1200 mm.

I. Support piping and tubing not listed in this article according to manufacturer's written instructions.

## 3.10 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
   2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
   4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for 65mm and larger.

## 3.11 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

## 3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:
   1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
      b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
   3. Re inspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for re inspection.
   4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:
   1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
   3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
   6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

## 3.13 ADJUSTING

A. Perform the following adjustments before operation:
   1. Close drain valves, hydrants, and hose bibbs.
   2. Open shutoff valves to fully open position.
   3. Open throttling valves to proper setting.
   4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

B. Clean non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

## 3.14 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use ball or gate valves for piping 50mm and smaller. Use butterfly, ball, or gate valves with flanged ends for piping 65mm and larger.
2. Hot-Water Circulation Piping, Balancing Duty: balancing valves.
3. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

D. PPR valves matching piping materials may be used.

# SECTION 221316
# FACILITY SANITARY SEWERAGE

# SECTION 221316
# FACILITY SANITARY SEWERAGE

## Part 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Sanitary Sewerage

B. Approved Manufacturers:

- UPVC
  1. Hepworth
  2. Uponor
  3. George Fisher
  4. Geberit (Switzerland)
  5. Valsir (Italy)
  6. Wavin
     Or approved equal

### 1.02 RELATED SECTIONS

A. Section 22 4100 Plumbing Fixtures

### 1.03 REFERENCES

A. BS 743 – Materials for damp-proof courses

B. BS EN 598 - Ductile iron pipes, fittings, accessories and their joints for sewerage applications. Requirements and test methods

C. BE EN 877 - Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings. Requirements, test methods and quality assurance.

D. BS 2494 - Specification for elstomeric joint rings for pipework and pipeline

E. BS 2494 – Elastomeric seals for joints in pipework and pipelines

F. BS 4515 – Unplasticised PVC soil and ventilation pipes

G. BS 4660 or to EN standrad - Unplasticized polyvinyl chloride (PVC-U) pipes and plastic fittings of nominal sizes 110 and 160 for below ground gravity drainage and sewerage

H. BS 5254 or to EN standard– Polypropylene waste pipe and fittings

I. BS 5572 or to EN standard – Sanitary pipework

J. BS 6076 – Tubular polythene film for use as protective sleeving for buried iron pipes and fittings

K. BE EN 12056 - Gravity drainage systems inside buildings.

## 1.04 SUBMITTALS

A. See Section 01 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on piping, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Shop Drawings:
   1. Submit preliminary layout of finished ceiling areas indicating only piping locations coordinated with ceiling installation.
   2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, components and accessories. Indicate system controls.
   3. Submit shop drawings to authority having jurisdiction for approval. Submit proof of approval to.

D. Project Record Documents: Record actual locations of piping and deviations of piping from drawings. Indicate drain and test locations.

E. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

F. Each type of imported pipe bedding material.

G. Each type of filter material.

## 1.05 QUALITY ASSURANCE

A. Maintain one copy of referenced design and installation standard on site.

B. Conform to UL requirements.

C. Design system under direct supervision of a Professional Fire Protection Engineer experienced in design of this type of work and licensed in Dubai..

D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

E. Installer Qualifications: Company specializing in performing the work of this section with minimum five years' experience approved by manufacturer.

F. It is the responsibility of this Contractor to make a detailed review of all drawings during the tender period, in order to fully comprehend the extent of the work to be completed. These drawings are schematic in nature and show the intent for the minimum requirements of the systems. Obstructions to pipe routing and obstructions to the location of piping are not shown on these drawings. It is this

Contractor's responsibility to locate and detail these obstructions as part of the scope of work. In addition it is this Contractor's responsibility to acquaint himself of all the drawings from the other disciplines – structural, electrical, and mechanical, during the tender phase, so that all of the interferences can be appreciated at the time of tender. No extras will be given for conditions that were known at the time of tender.

G. Give sufficient notice so that inspection may be made at the following stages
   1. Excavated surfaces
   2. Concealed or underground services.

## 1.06 PRE-INSTALLATION MEETING

Convene one week before starting work of this section.

## 1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

## 1.08 WARRANTY, RESPONSIBILITIES, MAINTENANCE AND ACCEPTANCE

A. Refer to Annex A, showing schedule of equipment warranties, maintenance obligations and financial security.

## Part 2 - PRODUCTS

### 2.01 SANITARY, WASTE, CONDENSATE, AND VENT PIPING at the risers and unoccupied spaces

A. PVCu Soil & waste systems shall be manufactured to BS EN 1329 :2000 formerly BS4514 & BS 5255.

B. All pipes and fittings shall strictly comply to the requirements of BSEN 1329 and carry the British Standard Kite mark where appropriate. Pipes and fittings shall be manufactured at the same manufacturing location and under the same quality control system.

C. Soil & Vent pipes, sizes 160mm, 110mm & 82mm shall be manufactured using PVCu with ring seal joints that will allow for expansion and contraction within the system.

D. Waste pipes, 50mm and below shall be manufactured from either High Temperature resistant MUPVC to BS EN 1566 or ABS to BS EN 1455 – 1: 200 with solvent weld joints. Where appropriate, all pipes and fittings shall carry the British Standard Kite mark and be manufactured under a single quality control regime in the same location.

E. Soil & Waste pipe sizing will reflect the number of discharge units that drain into the system as laid down by BS EN12056 – 2.

### 2.02 SANITARY, WASTE DRAINAGE AT occupied spaces (Not applicable)

A. Pipes and fittings used for the drainage should be made of sound proof piping system made from mineral supplemented polypropylene. The pipes should consist of three homogenous layers (polypropylene- mineral additives-polypropylene) with a sound insulation layer density must be 1.9gr/cm3.

B. Sound proof material should be tested and approved by the German standard DIN 52219: 1993-07 & DIN EN 14366 with a sound level not exceeding 16 dBA in the structure- born test and not more than 16dBA in the basement test-room UG rear without clamps.

### 2.03 KITCHEN WASTE PIPING FOR RESTAURANTS and f&b areas. (Not Applicable)

A. HDPE pipes shall stand for High Density Polyethylene with SDR 26 shall be used with fusion welded fittings to manufacturer's recommendations. Polyethylene is a semi crystalline thermoplastic that can have different densities. By coloring with 2% of "carbon black" the PE gets its black color.

B. HDPE has a high resistance against acids, bases and aqueous salt-solutions. Below 60°C it is practically unsolvable in organic solutions. The pipes and fittings shall conform the EN1519 specifications as below:

## 2.04 PIPE HANGERS AND SUPPORTS

A. For Drain, Waste, and Vent Pipe:
1. Hangers for Pipe Sizes 15 mm to 40 mm: Malleable iron, adjustable swivel, split ring.
2. Hangers for Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.
3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
4. Wall Support for Pipe Sizes to 80 mm: Cast iron hook.
5. Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.
6. Vertical Support: Steel riser clamp.
7. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
8. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
9. Construction of brackets and hanger exposing to weather shall be of stainless steel grade 316.

## Part 3 - EXECUTION

### 3.01 SANITARY DRAINAGE

A. Laying
Lay in straight lines between changes in direction or grade with sockets pointing up hill. If other pipes are adjacent, set each pipe true to line and complete each joint before laying the next pipe. If work is not continuous cap open ends to prevent entry of foreign matter.

B. Identification
Lay a detectable strip or plastic tape in the trench after pipe laying, testing and initial backfilling.

C. Pipe underlay
Bed piping on a continuous underlay of bedding material, at least 75 mm thick after compaction. Grade the underlay evenly to the gradient of the pipeline.
If necessary, form chases to prevent projections such as sockets and flanges from bearing on the trench bottom or underlay.

D. Pipe surrounds
Place the material in the pipe surround in layers □ 200 mm loose thickness, and compact without damaging or displacing the piping.

E. Anchor blocks
If necessary to restrain lateral and axial movement of the stormwater pipes provide reinforced concrete anchor blocks at junctions and changes of grade or direction. The top face of each block shall be covered with two layers of compressible packing complying with BS 743.

F. Encasement
Encase the pipeline in concrete at least 150 mm above and below the pipe, and 150 mm each side or the width of the trench, whichever is the greater. Where pipes with flexible joints are used, the concrete protection shall be interrupted over its full cross-section ate each pipe joint by a shaped compressible filler of bitumen impregnated insulating board to BS 1142 or equally compressible material.

G. Thermal movement
Arrange piping to accommodate thermal expansion. Provide proprietary expansion joints where pipe flexibility is not sufficient to absorb movement. Make sure that movement does not strain branch connections.

### 3.02 PIPING

A. Finishes
Finish exposed piping, including fittings and supports, as follows:

1. In internal locations such as toilet and kitchen areas shall be chrome plate copper piping.

2. Externally, and steel piping and iron fittings internally shall be painted.

3. In concealed but accessible spaces (including cupboards and non-habitable enclosed spaces) the contractor may leave copper and plastic unpainted except for identification marking. Prime steel piping and iron fittings.

B. Finish valves to match connected piping.

C. Conform to the Pipe support schedule.

D. Tolerances
Conform to the Pipeline tolerances table. These tolerances are conditional on falls to outlets being maintained and no part of a pipeline being at less than the designated gradient.

| | Permissible angular deviation from alignment | Permissible displacement from alignment |
|---|---|---|
| Horizontal | 1 in 300 | 15 mm |
| Vertical | 1 in 300 | 5 mm |

E. Acoustic Insulation
All waste and drainage pipes between residential units particularly when crossing noise sensitive spaces from different occupancies shall be externally wrapped with acoustic insulation. Refer to Section 22 0719 Plumbing Piping Insulation.

## 3.03 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as scheduled.

B. Install hangers to provide minimum 15 mm space between finished covering and adjacent work.

C. Place hangers within 300 mm of each horizontal elbow.

D. Use hangers with 40 mm minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

E. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.

F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

G. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

## 3.04 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage

## 3.05 COMPLETION

A. On com pletion clean and flush the whole installation.

# SECTION 221319
# SANITARY WASTE PIPING SPECIALTIES

# SECTION 221319
# SANITARY WASTE PIPING SPECIALTIES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Floor drains.
3. Roof flashing assemblies.
4. Through-penetration fire stop assemblies.
5. Miscellaneous sanitary drainage piping specialties.
6. Flashing materials.
7. Trench drain
8. Roof drain

### 1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.

### 1.4 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

1. Wiring Diagrams: Power, signal, and control wiring.

### 1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

## 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

## 1.7 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

## 1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

## 1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

## 1.10 WARRANTY, RESPONSIBILITIES, MAINTENANCE AND ACCEPTANCE

A. Refer to Annex A, showing schedule of equipment warranties, maintenance obligations and financial security

## PART 2 - PRODUCTS

### 2.1 CLEANOUTS

A. Floor Cleanout type FCO-1: to comprise PVC plugs with heavy duty PVC or stainless steel access cover similar to NICOLL, DALLMER, JOHNSPEC or approved equal.

### 2.2 FLOOR DRAINS

A. Floor drain type FD-1: PVC or stainless steel type, to have round flat strainer as manufactured by Nicoll or approved equal. Combined floor drain and integral trap seal to have 3 x 50 auxiliary side inlets and 75 mm side outlet, adjustable strainer permitting vertical adjustment of strainer height without disturbing flooring or connection during installation. As manufactured by Nicoll Dallmer or Josam or approved equal. Strainer body is to permit installation of different interchangeable strainer variations on same floor drain, and when needed to fit into an adjustable PVC extension collar. Access to the trap seal is to be made possible through a 12.5mm diameter opening fitted with a plastic cleanout plug.

### 2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:

      a. Acorn Engineering Company; Elmdor/ Stoneman Div.
      b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch- (1.6-mm) thick, lead flashing collar and skirt extending at least 10 inches (250 mm) from pipe, with galvanized-steel boot reinforcement and counter flashing fitting.
   1. Extended Vent Cap: With field-installed, vandal-proof vent cap.

### 2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Fire stop Assemblies :

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:

      a. Pro Set Systems Inc.

   2. Standard: UL 1479 assembly of sleeve and stack fitting with fire stopping plug.
   3. Size: Same as connected soil, waste, or vent stack.
   4. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
   5. Special Coating: Corrosion resistant on interior of fittings.

## 2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

    a. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
    b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.

B. Floor-Drain, Trap-Seal Primer Fittings :

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.

C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device :

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend **1 inch (25 mm)** above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings :

1. Description: Counter flashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Vent Caps

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.

2. Size: Same as connected stack vent or vent stack.

G. Expansion Joints :

1. Standard: ASME A112.6.4.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

## 2.6 FLASHING MATERIALS

A. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness, unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.

B. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.

C. Fasteners: Metal compatible with material and substrate being fastened.

D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

E. Solder: ASTM B 32, lead-free alloy.

F. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

## 2.7 TRENCH DRAIN MATERIALS

A. TRENCH Drains:
1. Standard: ASME A112.6.3 for trench drains
2. Material: Ductile or gray iron
3. Flange: required
4. Clamping Device: required
5. Outlet: Bottom
6. Grate Material: Ductile iron or gray iron, stainless steel
7. Grate Finish: To the Architectural finishes

## 2.8 ROOF DRAIN MATERIALS:

PVC dome strainer materials will be installed where opening are available in gutter drains to efficiently collect rain water from gutters while preventing debris, leaves, and other solids from entering inside pipes. Typically made of durable plastic. The drain features a perforated or mesh strainer that sits at the roof surface to filter out layer particules.
Strainer roof drains are often equipped with clamping rings or removable covers to allow easy cleaning and maintenance.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.

2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain unless otherwise indicated.

F. Install stack air-admittance valves at top of stack vent and vent stack piping.

G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

I. Install deep-seal traps on floor drains and other waste outlets, if indicated.

J. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

K. Install vent caps on each vent pipe passing through roof.

L. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

## 3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

## 3.3 FLASHING INSTALLATION

A. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.

B. Set flashing on floors and roofs in solid coating of bituminous cement.

C. Secure flashing into sleeve and specialty clamping ring or device.

D. Install flashing for piping passing through roofs with counter flashing or commercially made flashing fittings, according to Section "Sheet Metal Flashing and Trim."

E. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

F. Fabricate and install flashing and pans, sumps, and other drainage shapes.

## 3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

## 3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

## 3.6 DEMONSTRATION

A. Train Employer's maintenance personnel to adjust, operate, and maintain the drainage specialties systems

# SECTION 223300
# ELECTRIC WATER HEATERS

# SECTION 223300
# ELECTRIC WATER HEATERS

## PART 1 – GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Electric storage-type domestic water heaters.
2. Factory-applied thermal insulation.
3. Electric immersion heating elements.
4. Temperature and pressure relief valve.
5. Thermostat and safety controls.
6. Magnesium sacrificial anode.
7. Drain valve.
8. Mounting accessories.
9. Electrical connections.
10. All accessories required for complete installation.

### 1.2 RELATED SECTIONS

- Division 22 – Common Plumbing Requirements
- Section 22 05 23 – General Duty Valves
- Section 22 05 29 – Hangers and Supports
- Section 22 05 53 – Identification
- Section 26 05 00 – Electrical

### 1.3 REFERENCES

Equipment shall comply with the latest editions of:

- ISO 9001
- IEC 60335
- IEC 60529
- IEC 60204
- EN 60335
- NSF/ANSI 61
- Local Electrical Code
- ASHRAE 90.1
- UL 174 or UL 1453 as applicable for electric water heaters.
- International Mechanical Code (IMC)
- International Plumbing Code (IPC)

Electric water heaters shall be listed and labeled for potable water service and installed in accordance with applicable plumbing and mechanical codes.

## 1.4 SUBMITTALS

Submit:

A. Product Data.
Include:

- Manufacturer
- Model
- Capacity
- Dimensions
- Electrical characteristics
- Heating capacity
- Insulation thickness
- Storage tank construction
- Wiring diagram

B. Shop Drawings
Showing:

- Installation details
- Clearances
- Supports
- Plumbing connections
- Electrical connections

C. Manufacturer certificates.
D. Test certificates.
E. Warranty.
F. Operation and Maintenance Manuals.

## 1.5 QUALITY ASSURANCE

Manufacturer shall have:

- Minimum 10 years manufacturing experience.
- ISO 9001 certified manufacturing facility.

Products shall be factory assembled and factory tested.

## 1.6 WARRANTY, RESPONSIBILITIES, MAINTENANCE AND ACCEPTANCE

A. Refer to Annex A, showing schedule of equipment warranties, maintenance obligations and financial security

## PART 2 – PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

Subject to compliance with this Specification:

- A.O. Smith
- Ariston
- Atlantic
- Bosch
- Rheem
- Ferroli
- Tesy
- Thermor
- Elbi
- Equivalent approved

### 2.2 STORAGE TYPE ELECTRIC WATER HEATER

The water heater shall be factory assembled vertical storage type suitable for potable domestic hot water.

**Capacity**
Storage Capacity: **100 Liters**

**Installation**
Vertical wall-mounted

**Storage Tank**

- Heavy gauge steel construction
- Glass-lined enamel internal coating
- Corrosion resistant
- Suitable for potable water
- Maximum working pressure: **8–10 bar**

**External Casing**

- Powder coated steel
- White finish
- Corrosion resistant

**Thermal Insulation**

- High density polyurethane foam
- CFC free
- Injected insulation

Minimum insulation thickness:**40–50 mm**
Density:**40 ±5 kg/m³**
Maximum standing heat loss:Comply with ErP Energy Class C or better.

**Heating Element**

Type: Copper sheathed immersion element

Power:**1.5 kW minimum**

Supply Voltage:

- **230V**
- Single Phase
- 50 Hz

**Thermostat**

Adjustable
Temperature range:35°C–75°C
Factory preset:60°C
Accuracy:±3°C

**High Temperature Protection**

Manual reset safety thermostat.
Maximum trip temperature:95°C

**Internal Anode**

Factory installed magnesium sacrificial anode.
Replaceable.

**Temperature & Pressure Relief Valve**

Factory supplied.
Pressure setting:8 bar
Temperature setting:99°C
Complete with discharge connection.

**Drain Valve**

Factory supplied.
Minimum size: ½"

**Connections**

Cold water: ½"
Hot water: ½"

**Electrical Protection:**

Degree of Protection: Minimum **IP54**

**Energy Performance**

Energy Class: Minimum
**ERP Class C**
Preferred:**ERP Class B**

**Maximum Working Pressure:** 6–8 bar

**Test Pressure:** Minimum:10 Bar

**Operating Temperature:** Maximum: 75°C

**Electrical Cable**

Factory terminal block.
Complete with earth connection.

**Accessories**

Provide:

- Safety valve
- Drain valve
- Magnesium anode
- Adjustable thermostat
- High limit thermostat
- Wall mounting brackets
- Expansion anchors
- Installation template
- Thermometer (if available)

## 2.3 PERFORMANCE REQUIREMENTS

Tank shall withstand continuous operation at rated pressure.
Heating element shall be removable without replacing tank.
Standby heat losses shall comply with current energy efficiency requirements.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

Install in accordance with:
- Manufacturer recommendations
- IPC
- Local Authority requirements

Provide:
- Isolation valve
- Check valve
- Safety valve
- Drain connection
- Flexible connectors (where indicated)

### 3.2 ELECTRICAL CONNECTIONS

Electrical installation shall comply with IEC requirements.

Provide:

- Local isolator
- MCB
- Earth connection
- Residual Current Device (RCD)

### 3.3 TESTING

After installation:

- Fill tank completely.
- Vent all air.
- Pressure test.
- Verify no leakage.
- Check thermostat operation.
- Check safety thermostat.
- Check heating element.
- Verify electrical current.
- Verify insulation resistance.
- Demonstrate satisfactory operation.

### 3.4 COMMISSIONING

Commission complete system including:

- Thermostat adjustment
- Safety devices
- Heating cycle
- Water temperature
- Electrical load
- Leakage inspection

## 3.5 CLEANING

Remove all debris.
Clean equipment.
Leave unit ready for operation.

# SECTION 224100
# PLUMBING FIXTURES

# SECTION 224100
# PLUMBING FIXTURES

## PART 1 – GENERAL

### 1.1 SUMMARY

A. Section Includes:
1. Floor-mounted water closets with accessories.
2. Semi-pedestal lavatories with accessories.
3. Shower heads and shower mixer sets.
4. Fixture supports, trim, fittings, and installation accessories.

### 1.2 REFERENCES

Comply with the latest editions of:
- ASME A112.19.2 – Ceramic Plumbing Fixtures.
- ASME A112.18.1/CSA B125.1 – Plumbing Supply Fittings.
- ASME A112.4.2 – Water Closet Supports.
- NSF/ANSI 61 – Drinking Water System Components.
- NSF/ANSI 372 – Lead-Free Plumbing Products.
- EN 997 – WC Pans and WC Suites.
- EN 14688 – Wash Basins.
- EN 1111 / EN 817 – Mixing Valves.

### 1.3 SUBMITTALS

Submit:
- Manufacturer's Product Data.
- Technical Data Sheets.
- Shop Drawings.
- Color Samples.
- Operation and Maintenance Manuals.
- Warranty Certificate.

### 1.4 QUALITY ASSURANCE

Fixtures and fittings shall be manufactured by firms having a minimum of five (5) years' experience and shall be new, free from defects, and listed for potable water service.

### 1.5 WARRANTY, RESPONSIBILITIES, MAINTENANCE AND ACCEPTANCE

A. Refer to Annex A, showing schedule of equipment warranties, maintenance obligations and financial security.

## PART 2 – PRODUCTS

### 2.1 MANUFACTURERS

Subject to compliance with the Specification, provide one of the following:

- Geberit
- Ideal Standard
- Grohe
- Duravit
- Roca
- Villeroy & Boch
- Kohler
- TOTO
- American Standard
- Equivalent approved.

### 2.2 FLOOR-MOUNTED WATER CLOSET (EWC)

**A. General**

Provide vitreous China, floor-mounted, close-coupled or back-to-wall water closet suitable for commercial and residential applications.

**B. Construction**

- Vitreous China.
- White glazed finish.
- Wash-down or siphonic flushing action.
- Horizontal outlet unless otherwise indicated.
- Floor-mounted installation.

**C. Performance**

- Flush Volume: **Dual Flush 3/6 L** (preferred) or **Single Flush 6 L**.
- Rimless bowl preferred.
- Fully glazed internal trap way.

**D. Seat**

Provide heavy-duty:

- Thermoset plastic seat.
- Soft-closing.
- Quick-release hinges.
- Stainless steel hinges.

**E. Accessories**

Provide complete with:

- Concealed cistern or exposed dual-flush cistern as indicated.
- Dual-flush actuator plate or flush button.
- Angle stop valve.
- Flexible braided connector.
- Floor fixing bolts.
- Wax seal or neoprene gasket.
- Chrome-plated escutcheon.
- All fittings necessary for complete installation.

## 2.3 SEMI-PEDESTAL LAVATORY

### A. General
Provide wall-hung vitreous China lavatory complete with matching semi-pedestal.

### B. Construction
- Vitreous China.
- White glazed finish.
- Overflow opening.
- One faucet hole unless otherwise indicated.

### C. Faucet
Provide chrome-plated single-lever mixer complete with:
- Ceramic cartridge.
- Flexible braided hoses.
- Flow regulator (maximum 5–6 L/min).
- Aerator.
- Fixing kit.

### D. Accessories
Provide complete with:
- Chrome-plated bottle trap (32 mm).
- Chrome-plated angle valves.
- Flexible connectors.
- Pop-up waste.
- Overflow fitting.
- Wall fixing brackets.
- Silicone sealant.
- Semi-pedestal.
- All accessories required for complete installation.

## 2.4 SHOWER HEAD AND SHOWER MIXER

### A. Shower Head
Provide chrome-plated fixed wall-mounted shower head:

- Flow Rate: **Maximum 8–9 L/min**
- Anti-limescale silicone nozzles.
- Adjustable spray pattern.
- Minimum operating pressure: **1.0 bar**
- Maximum operating pressure: **5.0 bar**

### B. Shower Mixer
Provide concealed or exposed single-lever shower mixer as indicated:

- Brass body.
- Chrome-plated finish.
- Ceramic disc cartridge.
- Pressure balanced.
- Hot water temperature up to 70°C.
- Operating pressure: 1–5 bar.

**C. Accessories**

Provide complete with:

- Shower arm.
- Wall flange.
- Shower hose (if hand shower type).
- Hand shower and wall bracket where indicated.
- Connection fittings.
- Escutcheons.
- Concealed installation box where required.
- Isolation valves.
- All accessories necessary for complete installation.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

Install fixtures in accordance with the manufacturer's written instructions and approved shop drawings.

Provide all supports, anchors, seals, trims, and accessories required for a complete installation.

### 3.2 FIELD QUALITY CONTROL

- Verify proper alignment and secure fixing.
- Test all water supply and waste connections for leakage.
- Verify proper flushing and drainage.
- Check mixer operation, water flow, and temperature control.
- Adjust flush valves and flow regulators as required.

### 3.3 CLEANING AND PROTECTION

- Clean all fixtures after installation.
- Remove labels and protective coverings.
- Protect fixtures from damage until Substantial Completion.
- Replace damaged or defective fixtures before final acceptance.

# SECTION 231113
# FUEL OIL SYSTEM

# SECTION 231113
# FUEL OIL SYSTEM

## PART 1 – GENERAL

### 1.01 DESCRIPTION

A. This section shall cover the furnishing of all materials, labour, equipment and accessories necessary to the installation of fuel oil system, as shown on the Drawings and specified herein.

B. The extent of work shall include, but not necessarily limited to, fuel oil piping, storage tanks, pumps, meters, strainers, couplings, and all related accessories.

### 1.02 QUALITY ASSURANCE

A. Applicable Codes and Standards: NFPA 30. or equivalent BS standard.

B. Manufacturers: Firms regularly engaged in manufacture of fuel oil piping and equipment, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

C. Tests: Upon completion of works, systems shall be run in presence of the Engineer and proof shall be made that every system and component is operating in accordance with the drawings and specifications requirements.

D. Corrosion Prevention: Except as otherwise specified herein, equipment fabricated from ferrous metals shall be treated for prevention of corrosion by a factory coating or paint system.

### 1.03 SUBMITTALS

A. Manufacturer's Literature:

1. Required data shall include, but not necessarily be limited to:

   a. Manufacturer's name and model number.

   b. Equipment: Size, capacity, performance, materials and methods of construction, weight, electrical and mechanical connections, and installation recommendations.

B. Shop Drawings: Submit shop drawings for required fuel oil piping and equipment showing pipe and tube sizes; plan and elevation of pumps and integral component parts and auxiliary equipment including fittings and piping connections.

C. Recommended Spare Parts List: Submit list of recommended spare parts for each unit furnished under this Section. List shall include part numbers, a description of each part, and the price of each part.

## 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Equipment shall be delivered with factory-installed shipping skids. Accessories shall be packed in factory-fabricated fiberboard containers and with plastic end-cap protection on each end of pipe and tube to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.

B. Equipment and piping shall be handled carefully to avoid damage to components, enclosures and finishes. Damaged equipment shall not be installed. Damaged equipment shall be returned to manufacturer and replaced by new ones.

C. Equipment and piping shall be stored inside and protected from weather and construction traffic.

## 1.05 WARRANTY, RESPONSIBILITIES, MAINTENANCE AND ACCEPTANCE

A. Refer to Annex A, showing schedule of equipment warranties, maintenance obligations and financial security.

## PART 2 - PRODUCTS

### 2.01 FUEL OIL PIPING PRODUCTS

A. General: Provide factory-fabricated piping products of the size and type indicated. Where not otherwise indicated, provide products as determined by the Contractor to comply with installation requirements. Provide sizes and types matching piping and equipment connections.

B. Approved Manufacturers:
1. OPW, U.S.A.
2. Dyna Fab, U.S.A.
3. Viega, U.S.A.
Or approved equal

C. Pipes: Fuel oil piping shall be seamless black steel, Schedule 40 to ASTM A53/A106 grade B or BS1387 or approved equal.. Underground fuel piping shall be outside coated in accordance with AWWA C203.

D. Fittings: Buried fittings shall be forged steel socket welding fittings having a working pressure equal or higher than the above specified pipe. Above ground fittings shall be malleable iron threaded ends up to 50 mm diameter and forged steel welding type for 65 mm diameter and above.

E. Valves:
1. Pressure relief valves
2. Oil safety valves
3. Emergency shutoff valves (bronze bull valves with bronze trim)
4. Mechanical leak detection

### 2.02. FUEL OIL TANK

A. Approved Manufacturers:
1. Plasteel
2. Gulf Eternite
3. Viega US.A.
Or approved equal

B. ABOVE GROUND FUEL OIL TANK

Tank shall be constructed of not less than 4 mm. thick welded black steel sheet metal to the capacities indicated on Drawings, and in accordance with UL standard for steel above ground tanks for flammable and combustible liquids .UL. 142-1972.

Tank shall be tested for leaks before installation and shall be painted with two coats of red lead oxide or approved equal, and two coats black bituminous paint, and finished with Silver or White enamel paint.

Tanks shall be mounted on a concrete pad and an angle supported steel base above ground.

The tank shall be complete with the following connections and fittings:

- Screened air vent.
- Fill line inlet complete with isolation valve.
- Suction line feeder to generator complete with isolating valve.
- Return line from generator.
- Sludge drain valve.
- Protected oil level indicator fixed to the tank.
- Level switch sensor
- Digital level indicator
- 600 mm diameter or rectangular access openings. Each opening is to be fitted with a raised flanged lid securely hinged to the tank and sealed by gasket to provide tight joint against water admittance.

C. FILTERS

Dual type oil filters shall be fitted on the inlet side of the pumps.
The filters shall be equipped with a central changeover cock to permit isolation of either filter chamber and allow flow to continue.

The filters shall be line size, tested to 20.6 bar and shall have gunmetal body and covers, stainless steel internals with a stainless steel mesh element and be complete with brass drain plug. The elements shall be capable of filtration down to 100 microns.

## PART 3 - EXECUTION

### 3.01 INSTALLATION OF PIPING SYSTEM

General: Comply with the requirements of Division 15 sections for installation of basic piping materials. Install piping products in accordance with the manufacturer's written instructions, the applicable requirements of NFPA 30, and in accordance with recognized industry practices to ensure that products serve the intended function.
Remove cutting and threading burrs before assembling piping.
Do not install defective piping of fittings. Do no use pipe with threads, which are chipped, stripped or damaged.
Install fuel oil tank with anode in accordance with NFPA 30 and as shown on drawings.
Ground fuel oil piping system electrically within project, and bond to grounding electrode.

Prepare the exterior surfaces for painting by the complete wire brushing for removal of mill scale, rust, welding slag and other surface contaminants to leave a surface of uniform appearance, suitably roughened to receive the coating herein specified. After tank has been assembled, clean the surfaces of the tank thoroughly from all dirt debris. All surfaces shall be cleaned to bright metal and entire exposed surface shall receive two coats of coal tar primer and enamel.

Each coat shall be no less than 0.2 mm thick. Apply coal tar in strict accordance with the manufacturer’s instructions.

Coat all steel tank appurtenances such as hold down rods, turn buckles, etc., as herein specified for tank.

Handle tank in a manner which will preclude damage to the coating by impact or abrasion. After installation and prior to backfilling, tank shall be pressure-tested and proved tight at 35 Kpa pressure. Backfill shall be compacted thoroughly with care exercised to avoid damage to the tank’s coating; all foreign material such as bricks, gravel, etc., shall be thoroughly screened from backfill. Backfill material shall be thoroughly and mechanically tamped in courses of 30cm, with care exercised to avoid damage to tank covering. Backfill must not contain any ash, cinders, ironite, or other corrosive materials.

### 3.02 PROTECTION OF FUEL OIL PIPING AGAINST CORROSION

Protect metal fuel oil piping in contact with the earth, or other corrosive material, against corrosion. Seal wrap piping with coal tar saturated wrapping tape over coal-tar epoxy coating having not less than 0.5 mm thickness.

### 3.03 PROTECTION OF FUEL OIL TANKS AGAINST CORROSION

Protect fuel oil supply tanks against corrosion by installing protective finish or coating as recommended by the manufacturer.
Repair factory-applied external tank coating by touching-up those surfaces, which were chipped, scratched, or damaged during transit.

## 3.04 EQUIPMENT CONNECTIONS

General: Connect fuel oil piping to equipment in the manner shown and comply with equipment manufacturer's instructions where not otherwise indicated.

## 3.05 FIELD QUALITY CONTROL

A. Fuel Oil Piping Tightness Test: Prior to initial operation, test fuel oil piping in accordance with NFPA 30.

B. Repair or replace fuel oil piping as required to eliminate leaks, and retest as specified to demonstrate compliance.

# SECTION 233113
# METAL DUCTS

# SECTION 233113
# METAL DUCTS

## PART 1 – GENERAL

### 1.1 SUMMARY

A. Section Includes:
1. Galvanized steel air ducts.
2. Duct fittings and transitions.
3. Flexible duct connections.
4. Duct supports and hangers.
5. Access doors.
6. Volume control dampers.
7. Sealants and accessories.

### 1.2 REFERENCES

Comply with the latest editions of:
- SMACNA – HVAC Duct Construction Standards.
- ASHRAE Handbook – HVAC Systems and Equipment.
- ASTM A653/A653M – Galvanized Steel Sheet.
- ASTM A924 – Steel Sheet Metallic Coated.
- NFPA 90A – Air Conditioning and Ventilating Systems.
- DW/144 (where applicable).

### 1.3 SUBMITTALS

Submit:
- Manufacturer's Product Data.
- Duct Fabrication Details.
- Shop Drawings.
- Leakage Class Certification.
- Material Certificates.
- Operation and Maintenance Manuals.

### 1.4 QUALITY ASSURANCE

A. Fabricate ducts in accordance with SMACNA.
B. Use factory galvanized steel sheet with minimum G90 (Z275) zinc coating.

### 1.5 WARRANTY, RESPONSIBILITIES, MAINTENANCE AND ACCEPTANCE

Refer to Annex A, showing schedule of equipment warranties, maintenance obligations and financial security.

## PART 2 – PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- Duct fabricated by approved specialist manufacturer.
- Lindab
- Kingspan
- Metalaire
- Approved Equivalent.

### 2.2 GALVANIZED STEEL DUCTWORK

**A. Material**

- Hot-dip galvanized steel sheet.
- Zinc coating: **G90 (Z275) minimum**.
- Lock-formed construction.
- Reinforced in accordance with SMACNA.

**B. Minimum Sheet Thickness**

| Longest Duct Side | Thickness |
|---|---|
| Up to 300 mm | 0.60 mm |
| 301–750 mm | 0.80 mm |
| 751–1500 mm | 1.00 mm |
| Above 1500 mm | 1.20 mm |

**C. Construction**

Provide:

- Pittsburgh lock seams.
- Reinforcement as required by SMACNA.
- Airtight joints.
- Turning vanes.
- Radius elbows.
- Flexible canvas connections.
- Access doors.
- Volume control dampers.
- Hangers and supports.
- Duct sealant complying with SMACNA Seal Class A.

**D. Pressure Class**

- Low Pressure: ±500 Pa
- Medium Pressure: ±1000 Pa
- High Pressure: As indicated on drawings.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

A. Install ductwork in accordance with SMACNA and manufacturer's recommendations.
B. Seal all joints to SMACNA Seal Class A.
C. Support ducts with galvanized steel hangers and threaded rods.
D. Install access doors adjacent to all dampers and equipment.
E. Install flexible connections at fans and AHUs.

### 3.2 FIELD QUALITY CONTROL

- Inspect duct joints.
- Verify supports.
- Perform leakage testing where specified.
- Repair damaged galvanizing using zinc-rich paint.

### 3.3 CLEANING

Clean ductwork internally before commissioning.

# SECTION 23 33 13
# MOTORIZED FIRE DAMPERS

# SECTION 23 33 13
# MOTORIZED FIRE DAMPERS

## PART 1 – GENERAL

### 1.1 SUMMARY

A. Section Includes:
1. Motorized fire dampers.
2. Combination fire/smoke dampers.
3. Electric actuators.
4. Sleeve assemblies.
5. Retaining angles.
6. Installation accessories
.

### 1.2 REFERENCES

Comply with the latest editions of:
- NFPA 80.
- NFPA 90A.
- UL 555 – Fire Dampers.
- UL 555S – Smoke Dampers.
- AMCA 500-D.
- IEC 60335.

### 1.3 SUBMITTALS

Submit:
- Product Data.
- UL Certificates.
- Shop Drawings.
- Wiring Diagrams.
- Actuator Data.
- O&M Manuals.

### 1.4 QUALITY ASSURANCE

Fire dampers shall be UL Listed and installed in accordance with NFPA 80 and the manufacturer's instructions.

### 1.5 WARRANTY, RESPONSIBILITIES, MAINTENANCE AND ACCEPTANCE

Refer to Annex A, showing schedule of equipment warranties, maintenance obligations and financial security.

## PART 2 – PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- Ruskin
- Greenheck
- TROX
- Halton
- Nailor
- Aldes
- Approved Equivalent.

### 2.2 MOTORIZED FIRE DAMPERS

**A. General**
Provide UL-listed motorized fire dampers for installation in fire-rated walls and floors.

**B. Construction**
- Galvanized steel frame.
- Galvanized steel blades.
- Stainless steel blade axles.
- Low leakage blade seals.
- Dynamic rated.
- Minimum **2-hour fire rating** unless otherwise indicated.

**C. Actuator**
- Electric spring-return actuator.
- **24 VAC/DC** or **230 VAC** as scheduled.
- Fail-safe operation.
- Position indication.
- End switches.
- Manual override.

**D. Performance**
- Fire Rating: **2 Hours minimum**.
- Leakage: UL 555S Class I or II.
- Velocity Rating: **Up to 20 m/s**.
- Pressure Rating: **2000 Pa minimum**.

**E. Accessories**
Provide:
- Factory sleeve.
- Retaining angles.
- Breakaway duct connections.
- Access door.
- Thermal fuse.
- Junction box.
- Flexible conduit.
- Mounting hardware.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

A. Install fire dampers where ducts penetrate fire-rated walls, floors, shafts, and partitions.
B. Install in accordance with NFPA 80, UL listings, and the manufacturer's installation instructions.
C. Connect motorized dampers to the fire alarm and building management system where indicated.
D. Provide access panels for inspection and maintenance.

### 3.2 FIELD QUALITY CONTROL

A. Verify actuator operation.
B. Test opening and closing sequence.
C. Verify operation upon fire alarm signal and power failure.
D. Inspect installation before concealment.

### 3.3 CLEANING AND PROTECTION

A. Clean dampers after installation.
B. Protect dampers from dust and construction debris until final acceptance.

# SECTION 233416
# HVAC FANS

# SECTION 233416
# HVAC FANS

## PART 1 – GENERAL

### 1.1 SUMMARY

A. Section Includes:
1. Wall-mounted axial exhaust fans.
2. Floor-standing ducted centrifugal exhaust fans for roof installation.
3. Flexible duct connections, vibration isolation, roof curbs, weather hoods, dampers, and all accessories required for a complete installation.

### 1.2 REFERENCES

Comply with the latest editions of the following standards:
- AMCA 99 – Standards Handbook.
- AMCA 210 – Laboratory Methods of Testing Fans.
- AMCA 300 – Reverberant Room Method for Sound Testing of Fans.
- AMCA 301 – Certified Ratings Program.
- UL 507 – Electric Fans.
- IEC 60034 – Rotating Electrical Machines.
- ISO 5801 – Fan Performance Testing.
- ISO 14694 – Industrial Fans – Specifications for Balance Quality and Vibration Levels.

### 1.3 SUBMITTALS

Submit:
A. Manufacturer's Product Data.
B. Fan Performance Curves.
C. Sound Power Data.
D. Electrical Characteristics.
E. Shop Drawings.
F. Operation and Maintenance Manuals.
G. Warranty Certificate.

### 1.4 QUALITY ASSURANCE

A. Fans shall be factory assembled and factory tested.
B. Performance ratings shall be AMCA certified where applicable.
C. Motors shall comply with IEC requirements and be suitable for continuous duty.

### 1.5 WARRANTY, RESPONSIBILITIES, MAINTENANCE AND ACCEPTANCE

Refer to Annex A, showing schedule of equipment warranties, maintenance obligations and financial security

## PART 2 – PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

Subject to compliance with this Specification, provide one of the following:

- Soler & Palau (S&P)
- Systemair
- Greenheck
- Nicotra Gebhardt
- Rosenberg
- Fantech
- Vent-Axia
- Maico
- Approved Equivalent.

### 2.2 WALL-MOUNTED AXIAL EXHAUST FAN

#### A. General

Provide factory-assembled wall-mounted axial exhaust fan suitable for toilets, bathrooms, kitchens, laundry rooms and utility spaces.

#### B. Construction

1. UV-stabilized ABS or polypropylene housing.
2. Aerodynamically balanced axial impeller.
3. Corrosion-resistant construction.
4. Integral gravity backdraft shutter.
5. Suitable for continuous operation.
6. Wall-mounted installation.

#### C. Motor

1. Direct-drive motor.
2. Permanently lubricated sealed bearings.
3. Thermal overload protection.
4. Single Phase, 230 V, 50 Hz.
5. IPX4 minimum.
6. Insulation Class B minimum.

#### D. Performance

- Air Capacity: As scheduled.
- Static Pressure: Minimum 25 Pa.
- Maximum Sound Level: **40 dB(A)** at 3 m.
- Maximum Operating Temperature: **40°C**.

### E. Accessories

Provide complete with:

1. PVC duct connection.
2. Gravity backdraft damper.
3. Exterior weather louver.
4. Insect screen.
5. Wall sleeve.
6. Mounting hardware.

### F. Standard Outlet Sizes

- Ø100 mm
- Ø125 mm
- Ø150 mm

## 2.3 FLOOR-STANDING DUCTED CENTRIFUGAL EXHAUST FAN (ROOF MOUNTED)

### A. General

Provide heavy-duty floor-standing centrifugal duct fan suitable for roof installation and continuous operation.

### B. Construction

1. Heavy-gauge galvanized steel housing.
2. Backward-curved centrifugal impeller.
3. Dynamically balanced impeller.
4. Structural steel base frame.
5. Weatherproof construction.
6. Hinged inspection access door.
7. Outdoor duty.

### C. Motor

1. Totally Enclosed Fan Cooled (TEFC).
2. IE3 Premium Efficiency.
3. Three Phase, 400 V, 50 Hz.
4. IP55 minimum.
5. Insulation Class F.
6. Suitable for VFD operation.
7. Direct-drive or belt-drive as scheduled.

### D. Performance

- Air Capacity: As scheduled.
- Static Pressure: As scheduled.
- AMCA certified performance.
- Maximum Continuous Operating Temperature: **60°C**.

## E. Accessories

Provide complete with:

1. Flexible canvas connectors.
2. Spring vibration isolators.
3. Weatherproof roof curb.
4. Weatherproof discharge hood.
5. Bird screen.
6. Backdraft damper.
7. Anchor bolts.
8. Drain connection.
9. Lifting lugs.
10. Outlet flange.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

A. Install fans in accordance with the manufacturer's written instructions and approved shop drawings.

B. Securely mount wall-mounted fans with airtight PVC duct connections and weatherproof external louvers.

C. Install roof-mounted centrifugal fans on reinforced roof curbs complete with spring vibration isolators, flexible duct connectors and weatherproof flashing.

D. Provide sufficient access for inspection, servicing and motor replacement.

E. Connect electrical power and controls in accordance with Division 26.

### 3.2 FIELD QUALITY CONTROL

A. Verify fan rotation.
B. Measure airflow and static pressure.
C. Verify motor voltage and current.
D. Check vibration and noise levels.
E. Demonstrate satisfactory operation under design operating conditions.

### 3.3 CLEANING AND PROTECTION

A. Clean fan housings, impellers and accessories after installation.
B. Remove debris from duct connections.
C. Protect installed equipment from damage until final project acceptance.

# SECTION 233713
# AIR OUTLETS

# SECTION 233713
# AIR OUTLETS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conditions of Contract and Division 1 Specification Sections, apply to this Section.

### 1.2 DEFINITIONS

A. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.

B. Register: A combination grille and damper assembly over an air opening.

### 1.3 SUBMITTALS

A. Product Data: For each model indicated, include the following:

1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
3. Schedule of air outlets indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.

B. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of air outlets with other items installed in ceilings and walls.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for air outlets with factory-applied color finishes.

D. Samples for Verification: air outlets in manufacturer's standard sizes, showing the full range of colors. Prepare Samples from the same material to be used for the Work.

E. Source quality-control reports.

### 1.4 QUALITY ASSURANCE

A. Product Options: Drawings and schedules indicate specific requirements of air outlets and are based on the specific requirements of the systems selected. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 1 Section "Product Requirements."

B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

## 1.5 WARRANTY, RESPONSIBILITIES, MAINTENANCE AND ACCEPTANCE

A. Refer to Annex A, showing schedule of equipment warranties, maintenance obligations and financial security

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide product by one of the following or approved equal:

1. Trox – Germany
2. Systemair- Sweden
3. Titus – USA
4. Nailor Industries- Canada
5. Halton – Finland
6. Ruskin – USA
7. KBE- Lebanon

### 2.2 AIR-DIFFUSION DEVICE CONSTRUCTION

A. Air-diffusion device construction and mounting shall preclude flutter, rattle, or vibration. Devices shall have the modifications and accessories necessary for mounting in indicated surface construction.

B. Color selection shall be as directed by the Engineer.

C. Air-diffusion shall be provided with combination damper and equalizing grid. Dampers shall be extracting-splitter type, except as otherwise indicated.

D. Air-diffusion shall be selected to give required throw to nearest wall. Terminal velocity is not to exceed 0.5 m/s specified air quantity. Velometer velocities through diffuser are not to exceed 3.0 m/s. Supply diffusers are to be able to deliver air for cooling at 15 deg. C below room temperature without causing objectionable conditions.

E. Air-diffusion device volume and pattern adjustments shall be made from the face of the device.
Volume adjustments shall be made by **removable key**.

F. Gaskets shall be provided for supply-terminal air devices mounted in finished surfaces.

G. Exterior and exposed edges shall be rolled, or otherwise stiffened and rounded.

H. For ductwork of pressure classes 1000 to 2500 Pa (4 to 10 inch water gage), provide sponge- rubber gasket between flanges and wall or ceiling.

I. Size air outlets for minimum noise levels, not to exceed 30 db at specified air quantity, as measured on the A-scale of a standard noise level meter, unless specified otherwise.

### 2.3 SOURCE QUALITY CONTROL

A. Testing: Test performance according to ASHRAE 70, "Method of Testing the Performance of Air Outlets and Air Inlets."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine areas where air outlets are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. Install air outlets level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.

B. Install air outlets with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 3.3 ADJUSTING

A. After installation, adjust air outlets to air patterns indicated, or as directed, before starting air balancing.

### 3.4 CLEANING

A. After installation of air outlets inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace air outlets that have damaged finishes.

### 3.5 REGISTERS AND GRILLES SCHEDULE

A. Fixed Face Grille :

1. Material: **Aluminum**.
2. Finish: **Baked enamel, color selected by Engineer**.
3. Mounting: **Countersunk screw**.
4. Damper Type: **Adjustable opposed blade**.
5. Accessories:

    a. **Front**-blade gang operator.
    b. Filter.

# SECTION 235123
# GENERATOR ENGINE EXHAUST SYSTEM

# SECTION 235123
# GENERATOR ENGINE EXHAUST SYSTEM

## PART 1 – GENERAL

### 1.01 SUMMARY

A. Section Includes:

1. Generator engine exhaust flue piping.
2. Seamless black steel exhaust pipes.
3. Thermal insulation for exhaust piping.
4. Aluminum cladding.
5. Exhaust muffler/silencer.
6. Flexible stainless-steel connectors.
7. Flexible stainless-steel elbows.
8. Spark arrestor.
9. Diesel Oxidation Catalyst (DOC) filtration unit.
10. Exhaust supports and hangers.
11. Roof penetration and flashing.
12. Rain cap/weather hood.
13. Accessories required for a complete operating system.

### 1.02 REFERENCES

A. ASTM International

- ASTM A105 – Carbon Steel Forged Flanges.
- ASTM A106 Grade B – Seamless Carbon Steel Pipe.
- ASTM A53 Grade B (where permitted).
- ASTM A234 WPB – Carbon Steel Butt – Welding Fittings

B. ASME

- ASME B31.1 – Power Piping.
- ASME B16.9 – Factory-Made Wrought Steel Butt-Welding Fittings.
- ASME B16.5 – Pipe Flanges.
- ASME B36.10M – Welded and seamless wrought steel pipe
  (Pipe dimensions and wall thickness, including schedule 40)

C. NFPA

- NFPA 37 – Installation and Use of Stationary Combustion Engines and Gas Turbines.
- NFPA 110 – Emergency and Standby Power Systems.
- NFPA 30- Flammable and combustible liquids code
- NFPA 70- National electrical code (NEC)

D. ISO

- The generator manufacturer shall be certified to ISO:9001 Quality Management System

## 1.03 SUBMITTALS

a. Product Data.
b. Shop Drawings.
c. Manufacturer's Installation Instructions.
d. Exhaust pressure drop calculations.
e. Catalyst performance data (emissions reduction efficiency and pressure drop)
f. Muffler/ silencer performance data. (Noise attenuation/insertion loss and back pressure)
g. Acoustic performance data.
h. Insulation details.
i. Pipe supports and hangers details
j. Expansion joint / flexible connector details
k. Materials certificates for pipes, fittings, flanges, and insulations.
l. Welding procedure specifications (WPS) and welder qualifications.

## 1.04 WARRANTY, RESPONSIBILITIES, MAINTENANCE AND ACCEPTANCE

A. Refer to Annex A, showing schedule of equipment warranties, maintenance obligations and financial security.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

**A. Exhaust Pipe**

1. Tenaris
2. Vallourec
3. Nippon Steel
4. Jindal Steel
5. ArcelorMittal
   or approved equal.

**B. Muffler / Silencer**

1. Nelson Global
2. Donaldson
3. Dinex
4. Cummins
5. MANN + Hummel
   or approved equal.

**C. Flexible Stainless-Steel Connectors**

1. Senior Flexonics
2. BOA Group
3. EagleBurgmann
4. Metraflex
5. Hyspan precision products
   or approved equal.

**D. Diesel Oxidation Catalyst (DOC)**

1. Johnson Matthey
2. Eminox
3. Dinex
4. Cummins Emission Solutions
5. Donaldson
   or approved equal.

**E. Insulation**

1. ROCKWOOL
2. Owens Corning
3. Knauf Insulation
4. Saint-Gobain Isover
   or approved equal.

### 2.02 EXHAUST FLUE PIPING

Provide:

- **ASTM A106 Grade B** seamless carbon steel pipe.
- Schedule 40.
- Minimum wall thickness 4 mm.
- Butt welded joints.
- Heavy-duty supports.
- High-temperature resistant paint after fabrication.

## 2.03 EXHAUST PIPE INSULATION

Provide:

- 50 mm thick mineral wool / rock wool.
- Density 80–120 kg/m³.
- Service temperature minimum 650°C.
- Aluminum cladding 0.6–0.8 mm thick.
- Stainless steel bands at maximum 300 mm spacing.

## 2.04 MUFFLER / SILENCER

Provide heavy-duty industrial critical-grade exhaust silencer including:

- Acoustic insulation.
- Spark arrestor.
- Stainless steel flexible connector.
- Flanged connections.
- Suitable for continuous generator operation.
  Noise attenuation shall not be less than **30–35 dBA**, unless otherwise indicated.

## 2.05 FLEXIBLE CONNECTION

Provide stainless steel braided flexible exhaust connector complete with:

- Stainless steel bellows.
- Flanged ends.
- Vibration isolation.
- Minimum temperature rating 650°C.

## 2.06 FLEXIBLE STAINLESS-STEEL ELBOWS

Provide stainless steel exhaust elbows at generator outlet suitable for:

- Thermal expansion.
- Engine vibration.
- Continuous operation.

## 2.07 DIESEL OXIDATION CATALYST (DOC)

Provide factory-manufactured Diesel Oxidation Catalyst suitable for a **500 kVA** diesel generator.

The catalyst shall:

- Reduce Carbon Monoxide (CO).
- Reduce Hydrocarbons (HC).
- Reduce particulate matter.
- Be stainless steel construction.
- Have minimum 90% reduction efficiency for CO and HC under rated operating conditions.
- Be designed for exhaust temperatures up to 650°C.

## 2.08 EXHAUST TERMINATION

Provide:

- Exhaust discharge extending minimum **2 m above roof level**, or as required by local regulations.
- Rain cap/weather hood.
- Bird screen where permitted.
- Drain connection at lowest point.
- Flashing and weatherproof roof penetration.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

Install the complete exhaust system in accordance with the manufacturer's recommendations and NFPA 37.

### 3.02 SUPPORTS

Provide heavy-duty galvanized or painted steel supports designed to withstand thermal expansion and vibration.

### 3.03 INSULATION

Install insulation continuously over the complete exhaust piping system, including fittings and accessories.

### 3.04 TESTING

- Verify proper alignment.
- Check for exhaust leakage.
- Verify allowable engine back pressure.
- Measure vibration levels.
- Demonstrate satisfactory operation under full-load conditions.
- Submit commissioning and test reports.

# SECTION 238126
# DX SPLIT A/C SYSTEM

# SECTION 238126
# DX SPLIT A/C SYSTEM

## Part 1 - GENERAL

### 1.01 SUMMARY

A. Section Includes: Split DX. cooling units complete in accordance with the requirements of the Contract Documents. Work includes but is not limited to the following :
   1. Split DX. cooling units.

### 1.02 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights, furnished specialties and accessories; and installation and start-up instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring for split DX. cooling units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field installed.

### 1.03 QUALITY ASSURANCE

A. Manufacturers Qualifications : Firms regularly engaged in manufacturer of Air Filters units of types and capacities required whose products have been in satisfactory use in similar service for not less than 5 years.

B. Regulatory Requirements:
   1. ASHRAE Compliance: Construct refrigeration system of split DX. cooling units in accordance with ASHRAE Standard 15 "Safety Code for Mechanical Refrigeration".
   2. UL Compliance: Provide split DX. cooling units which are designed, manufactured, and tested in accordance with UL requirements.

### 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Handle split DX. cooling units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged split DX. cooling units or components; replace with new.

B. Store split DX. cooling units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with Manufacturer's rigging and installation instructions for unloading split DX. cooling units, and moving them to final location.

## 1.05 WARRANTY, RESPONSIBILITIES, MAINTENANCE AND ACCEPTANCE

A. Refer to Annex A, showing schedule of equipment warranties, maintenance obligations and financial security.

## Part 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Split DX. Coolings Units :
   1. Carrier, U.S.A.
   2. Daikin, Japan
   3. Hitachi, Japan
   4. Trane Co., France, Malaysia
   5. York, U.S.A., Malaysia
   6. Mitsubishi, Japan
   7. Gree
      Or approved equal

B. The products or manufacturers listed herein are included for the purpose of establishing minimum quality standards. Products equal in quality or better than those specified will be considered if they are produced by a specialized manufacturer whose units are equal in every respect and have been in similar service for not less than five (5) years. The decision of acceptability shall rest with the Engineer.

### 2.02 MATERIALS

A. Split D/X Units
   1. General: Provide factory-assembled and tested split DX. units as indicated, designed for roof, slab or floor mounting, consisting of compressors, condensers, evaporator coils, refrigerant piping, condenser and evaporator fans, refrigeration and temperature controls, filters, and dampers. Provide capacities and electrical characteristics as scheduled.
   2. Casing: Provide manufacturer's standard casing construction, corrosion protection coating, and exterior finish. Provide removable panels and/or access doors for inspection and access to internal parts.
      Insulate casing with 1" thick minimum thermal insulation. Provide knockouts for electrical and piping connections. Provide condensate drain connection, and lifting lugs.
   3. Evaporator Fans: Provide forward-curved, centrifugal, belt-driven fans with adjustable sheaves and permanently lubricated motor bearings.
   4. Condenser Fans: Provide propeller-type, direct-driven fans with permanently lubricated bearings.
   5. Coils: For evaporator and condenser, provide non-ferrous construction with aluminum plate fins mechanically bonded to seamless copper tubes; with brazed tubing joints. Circuit evaporator to provide full active face on minimum cooling step. For condenser provide 25% extra surface area. Aluminum fins shall be with corrosion protection coated.
   6. Compressors: Provide serviceable, semi-hermetic, or hermetic compressors. Provide vibration isolators, and crankcase heaters which de-energize during compressor operation.
      a. Provide cylinder un-loaders for capacity control, with minimum steps as scheduled.

b. Provide thermal expansion valves, filter dryers, sight glasses, compressor service valves, liquid line service valves; and provide minimum of 2 refrigerant circuits for units having 2 or more compressors. Provide fan- cycling control for low ambient control to 45°F (7°C).

7. Safety Controls: Provide the following controls:
   a. Low pressure cutout, manual reset.
   b. High pressure cutout, manual reset.
   c. Compressor motor overload protection, manual reset.
   d. Anti-recycling timing device.
   e. Adjustable low-ambient lockout.
8. Refrigerant Piping and Fittings
   a. Refrigerant pipes installed in the field shall consist of copper tubing and recessed solder joint fittings. Tubing shall be in accordance with ASTM Specification B 88-61 type 'K' hard drawn. Fittings shall be wrought copper or tinned cast brass. Where required for connection to gauges and control devices, tubing not larger than 3/8 inch. O.D. may be type 'K' soft (annealed) with flared tube or double ferrule compression fittings suitable for high pressure. On all joints in refrigeration piping flux and solder which is recommended by solder type fittings manufacturer shall be used. Tubing shall be protected against oxidation during silver soldering by use of dry nitrogen flowing through the tubing.
   b. Refrigerant stop valves shall be of the back seating, key operated seal cap type. Valves which must be opened and closed in regular operation shall have hand wheels and shall be of the backless type. Valves connected to copper tubing shall have solder type ends or flanged ends and soldered flange adapters.
   c. Accessories for field assembled refrigerant piping systems such as oil separators, liquid receivers, heat exchangers, driers, expansion valves, refrigerant strainers, sight glass etc., shall be in accordance with instructions of the units manufacturers standard practice and specific recommendations.
   d. Drain line shall be of copper pipe type "L" fitted with dielectric fitting to drain pan.
   e. Refrigerant pipes shall be thermally insulated with moulded factory shape sectional pipe covering closed cell elastomeric foam rubber insulation with density 65-80 kg/m3 having a thermal conductivity factor of 0.037 W/m.k at 20 deg. C and 0.040 W/m. K at 40 deg. C.

      1. Insulation thickness shall not be less than 25 mm.
      2. Insulate and finish valves and fittings in the same manner and same thickness as piping in which such items are installed.
      3. External refrigerant pipe insulation shall be covered with 20 x 20 woven glass cloth cover. The cloth cover shall be protected and coated with two coats of waterproof sealant.

9. Filters: Provide filter section consisting of 2" thick fiberglass throwaway filters in filter rack, with maximum face velocity of 300 fpm.

B. Automatic Temperature Control System: Provide combination thermostat and fan switches to control the room temperature automatically, Provide factory fabricated unit of the same manufacturer of DX-Split unit having sensor, 4-

position push button or lever operated manual switch for control of fan compressor interlock and control transformer as an integral part of the unit.

C. Electrical: Provide 240 V convenience outlet, separately fused, for unit service. Provide means for unit power connection through unit cabinet.

D. Accessories:
   1. Anti-Recycling Control : Provide controls to automatically prevent compressor restart for 5-minutes after shutdown.
   2. Time Guard: Provide time guards to prevent short cycling of compressors.

## 2.03 SOURCE QUALITY CONTROL

A. Test and rate split DX. cooling units of 135,000 btu/hr capacity or over in accordance with ARI 360 “Standard for Commercial and Industrial Unitary Air-Conditioning Equipment”.

B. Test and rate split DX. cooling units under 135,000 btu/hr capacity in accordance with ARI 210 “Standard for Commercial and Industrial Unitery Air-Conditioning Equipment”, and provide Certified Rating. Sound test and rate units in accordance with ARI 270 “Standard for Sound Rating of Outdoor Unitary Equipment”, and provide Certified Rating.

## Part 3 - EXECUTION

### 3.01 EXAMINATION

A. Examine areas and conditions under which split D/X cooling units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION OF SPLIT DX. COOLING UNITS & MINI SPLIT

A. General: Install split DX. cooling units and mini split units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in approved locations, and maintain manufacturer's recommended clearances.

B. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal.

### 3.03 START-UP

A. Start-up split DX. cooling units, mini split units and room air-conditioners in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Balance split DX. unit systems to verify its capacity and balanced delivery of air for each space.

### 3.04 GROUNDING

A. Provide Positive equipment ground for split DX. cooling unit, mini split units and room air- conditioners components.